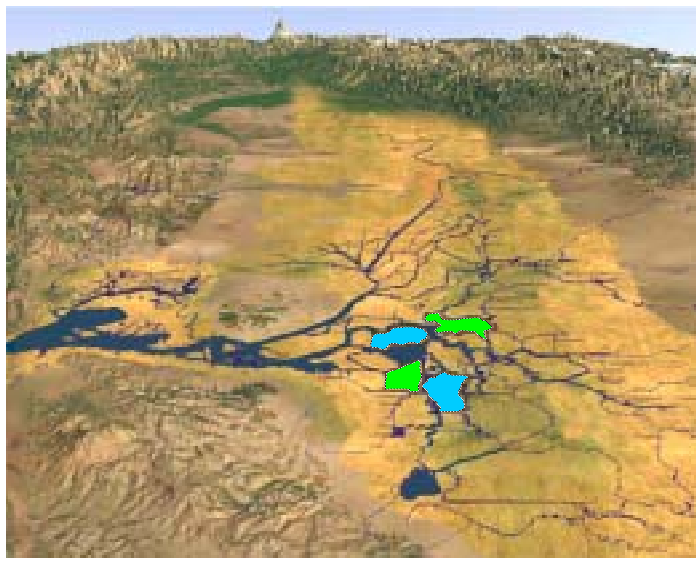
INTEGRATED STORAGE INVESTIGATIONS

IN-DELTA STORAGE PROGRAM
STATE FEASIBILITY STUDY
DRAFT ENVIRONMENTAL EVALUATIONS



CALIFORNIA BAY-DELTA AUTHORITY

DEPARTMENT OF WATER RESOURCES · STATE OF CALIFORNIA

Division of Planning and Local Assistance
Department of Water Resources

July 2003

ORGANIZATION

FOREWORD

We acknowledge the technical assistance provided by Reclamation in carrying out the role of federal lead agency for the CALFED Integrated Storage Investigations. Reclamation has not yet completed a full review of the State Feasibility Study reports. Reclamation will continue to provide technical assistance through the review of the State Feasibility Study reports and DWR will work with Reclamation to incorporate comments and recommendations in the final reports.

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Abbreviations

ACHP	Advisory Council on Historic Preservation
AFRP	Anadromous Fish Restoration Program
BA	Biological Assessment
BCDC	San Francisco Bay Conservation and Development Commission
BDAC	Bay-Delta Advisory Council
BMPs	best management practices
ºC	degrees Celsius
CC	Clifton Court
CCC	Contra Costa Canal
CCCGP	Contra Costa County General Plan
CCF	Clifton Court Forebay
CCWD	Contra Costa Water District
CDC	California Department of Conservation
CDF	California Department of Forestry and Fire Protection
CDFA	California Department of Food and Agriculture
CEPA	California Environmental Protection Agency
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
CSC	California species of concern
CUWA	California Urban Water Agency
CVFFRT	Central Valley Fish Facilities Review Team
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWHRS	California Wildlife Habitat Relationships System
D-	Water Rights Decision
DBW	Department of Boating and Waterways
DCC	Delta Cross Channel
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
Delta	Sacramento-San Joaquin Delta
DFG	Department of Fish and Game
DO	dissolved oxygen
DOC	Department of Conservation
DPC	Delta Protection Commission
DSOD	Division of Safety of Dams
DW	Delta Wetlands
DWP	Properties Delta Wetlands Properties
DWR	Department of Water Resources

ABBREVIATIONS

ESA	Endangered Species Act
ESA	Environmental Site Assessment
Estuary	Sacramento-San Joaquin Estuary
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERP	Ecological Restoration Program
EWA	Environmental Water Account
ºF	degrees Fahrenheit
FE	Federal Endangered
FOC	Final Operations Criteria
fps	feet per second
FSC	Federal Species of Concern
FT	Federal Threatened
GGS	giant garter snake
GIS	geographic information system
HEP	Habitat Evaluation Procedures
HCP	Habitat Conservation Plan
HMAC	Habitat Management Advisory Committee
HMP	Habitat Management Plan
HPMP	Historic Property Management Plan
HSI	Habitat Suitability Index
HU	Habitat Units
IEP	Interagency Ecological Program
ISDP	Interim South Delta Program
JSA	Jones and Stokes Associates
LESA	Land Evaluation and Site Assessment
MAF	million acre-feet
mm	millimeter
MOA	memorandum of agreement
MOU	memorandum of understanding
MSL	mean sea level
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OPR	Governor’s Office of Planning and Research
PG&E	Pacific Gas and Electric
RAB	riverine aquatic bed
Reclamation	U.S. Bureau of Reclamation
ROD	CALFED Record of Decision
RWQCB	Regional Water Quality Control Board
SACR	Sandhill Crane
SE	state endangered

ABBREVIATIONS

SHPO	State Historic Preservation Officer
SJMSCP	San Joaquin County Multi-Species Habitat Conservation and Open Space Plan
SLC	State Lands Commission
SRA	shaded riverine aquatic
SSC	state species of concern
ST	state threatened
SWHA	Swainson's Hawk
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VELB	valley elderberry longhorn beetle
WQCP	water quality control plan

Chapter 1.0 Executive Summary

In 2002, DWR staff continued evaluations of the In-Delta Storage Project. The environmental evaluations were based on the recommendations made in the In-Delta Storage Program Planning Study Report on Environmental Evaluations (CALFED 2002b), and were focused in the following resource areas: land use, botanical, wildlife, cultural, aquatic, hazardous materials, and recreation.

During the 2002 public review and CALFED Science review periods, DWR staff received conflicting comments on the impacts of the In-Delta Storage Project on agricultural land and the need for mitigation. Results from the Land Evaluation and Site Assessment indicated that conversion of Webb Tract and Bacon Island from agricultural uses to reservoir storage will result in a significant impact to agricultural land. A LESA evaluation was not completed for Holland Tract and Bouldin Island since the detailed use of the islands under the revised Habitat Management Plan was unclear at the time of the evaluation. The purchase of agricultural easements to mitigate the impacts of converting Webb Tract and Bacon Island to nonagricultural uses could cost up to $12 Million. Additional work should be done to determine the implications of acquiring 10,003 acres of agricultural easements on the financial feasibility of the In-Delta Storage Project and the implementation of ERP actions in the Delta.

DWR botanists conducted special status plant surveys in spring through fall 2002. The 2002 surveys located 111 occurrences of special status plant taxa on the exterior levees of the project islands, 34 more than were found in the 1988 surveys. No occurrences were found in the interior of any island in 2002. The populations of three special status plant species on the levees increased and one decreased from levels seen in 1988. Botanists also identified a new species not previously found in the Delta. Impacts from levee modifications or placement of additional riprap will occur to 5 special status species. Mitigation for levee modifications/riprap can be incorporated into the Habitat Management Plan.

DWR biologist conducted wildlife surveys and habitat assessments for listed and special-status species to determine the potential impacts and mitigation required under federal and State environmental laws. DWR determined that additional suitable habitat for the giant garter snake was present on Webb Tract, Bacon Island, Bouldin Island, and Holland Tract. Western pond turtles were found on and near all the project islands. The number of nesting Swainson's hawks on or near Webb Tract and Bacon Island increased. Also, greater sandhill cranes were located on all project islands. Crane foraging habitat has increased by 38% from 1988. DWR biologist did not locate any California black rails on the adjacent in-channel islands. Loggerhead shrikes were located on all project islands, but were more abundant on Holland Tract and Bacon Island. Nesting tricolored blackbirds were not located on the project islands. Wintering tricolored blackbirds were identified on Bacon Island and Webb Tract foraging. Burrowing owls were not found on any of the project islands. Suitable bat foraging and roosting habitat was identified on all project islands, however, active bat roosts were not detected.

DWR developed a revised Habitat Management Plan that includes specific habitat types and amounts to mitigate for the potential impacts to giant garter snake, Swainson's hawks, greater sandhill cranes and the other special-statue species. The habitat types include: emergent marsh, permanent pond, canal, cottonwood-willow woodland, great valley willow scrub, herbaceous upland, corn, wheat, alfalfa and other harvested crops. Additionally, a total of 3,900 acres of conservation easement would be required to fully mitigate for impacts to Swainson's hawk foraging habitat. The revised HMP includes mitigation for wetlands and open water impacts.

The Davis-Dolwig Act (Act) declares that recreation and the enhancement of fish and wildlife resources are among the purposes of state water projects and acquisition of real property for such purposes be planned concurrently with the project. The Act applies to water storage projects constructed by the State or by the State in cooperation with the Federal government. DWR’s responsibilities under the Act include planning for recreation and for fish and wildlife preservation (mitigation) and enhancement, and acquiring land for such uses. The recreational features mentioned in the Act include campgrounds, picnic areas, water and sanitary facilities, parking areas, viewpoints, boat launching ramps, and any others necessary to make project land and water areas available for use by the public. DWR planning for public recreation use and fish and wildlife preservation and enhancement is to be part of the general project formulation activities and done in close coordination, consultation, and cooperation with Parks, DFG, Department of Boating and Waterways, and all appropriate federal and local agencies. DWR is to give full consideration to the recommendations provided by such other departments and agencies.

Changes to the recreation plan may be made during the Subsequent EIR/EIS and ESA/CESA consultation process and during discussions with State Parks, Boating and Waterways and local agencies. Potential conflicts may exist between the proposed hunting and sandhill crane use on the habitat islands. Boat dock placement should consider the existing special status plant populations on all levees. It should be possible to modify the recreation plan to accommodate both recreation and threatened and endangered species needs

A Historic Properties Management Plan was developed by consultants to mitigate the adverse effects of the DW project on historic properties located on Webb and Holland Tracts and Bouldin and Bacon Islands and to address the management of cultural resources once the proposed project has been implemented. The HPMP expands upon the 1998 Programmatic Agreement Among the U.S. Army Corps of Engineers, California State water Resources Control Board, California State Historic Preservation Officer, Advisory Council on Historic Preservation, and Delta Wetlands Properties Regarding the Implementation of the Delta Wetlands Project and the 2002 In-Delta Storage Program Planning Study on Environmental Evaluations. In May 2002, DW cultural resource consultants conducted limited archaeological shovel testing at historic-era archaeological sites associated with the Rural Historic District found on Bacon Island. The results of this testing resulted in the HPMP recommendation that only six of the ten recorded sites within the Historic District be subject to data recovery efforts, in contrast to the 2002 In-Delta Storage Project proposal that all ten sites receive treatment. Other than the recommendation to reduce the number of sites tested on Bacon Island, the HPMP differs very little from the 2002 In-Delta Storage Project proposal. One minor difference involves the cultural resources on Holland Tract. The HPMP recommendation is limited to monitoring previously recorded archaeological sites on this tract once the DW/In-Delta Storage Project is implemented. While such monitoring is valid and supportable, DWR recommends additional tasks outlined in the 2002 In-Delta Storage Project, specifically re-survey of the Piper Sand soils and the updating of site records prior to implementation of the proposed project.

DWR's Site Assessment Section conducted a Phase II Environmental Site Assessment (ESA) for the In-Delta Storage Program. The purpose of this Phase II ESA was to evaluate the nature and extent of suspected hazardous substance contamination as identified in the modified Phase I ESA for the Site dated December 2001. In September 2002, DWR staff collected a total of 77 soil samples at the Site. High levels of petroleum hydrocarbons, such as oil and grease, were detected at the vehicle and farm equipment maintenance facilities, especially in areas around or near fuel and lubricating oil tanks. Low concentrations of other potential contaminants, such as heavy metals, chlorinated pesticides, and organic solvents were also detected on each property. However, in each instance, their levels never exceeded the Total Threshold Limit Concentrations as established in California regulations.

Based on the results of the Phase II ESA sampling, DWR staff recommends further investigation of the identified “hot spot” areas to better delineate the extent of contamination. Further investigation may include more invasive subsurface soil sampling, surface water and groundwater sampling, and environmental fate studies for each of the contaminants of concern.

DWR staff also recommends that any contaminated soil at or near water supply well sites be removed and properly disposed of, or remediated, depending on the extent of contamination.

Lastly, DWR staff recommends that all measures be taken to indemnify the State from any liability associated with future hazardous substance contamination or remedial actions associated with the natural gas wells that are present throughout the Site. At this time, these gas wells and the parcels on which they are situated may not be part of the land acquisition for the Project. Such measures may include establishing baseline soil and groundwater sampling data for the properties surrounding the gas wells or inserting indemnification clauses in each of the proposed purchase agreements.

Nine listed or sensitive fish species occur in the In-Delta Storage Project area that could be affected by the project. Additional fisheries impact analyses will be needed as changes in reservoir operations are proposed in project development. DWR will coordinate with fishery agencies to determine the appropriate means of achieving endangered species acts compliance

DWR redesigned the fish screens to bring the screens into compliance with current standards that meet the restrictions in the Final Operations Criteria, biological opinions, and incidental take permit. Technical experts from various resource agencies provided suggestions to improve the fish screen design and layout, which were incorporated into the plans.

Preliminary estimates are that levee protection measures could eliminate 80 acres of shallow water habitat from the perimeters of Bacon Island and Webb Tract. Additional analysis will be conducted to determine the specific impacts to shallow water habitat once the levee protection measures and recreation development plans are refined.

The delta smelt diversion criteria in D 1643 results in reduction of project yield. Details of operational runs for fisheries operations are given in Chapter 3 on Operations. Developing current size and distribution estimates for delta smelt abundance is difficult. Predicting the size and distribution of delta smelt abundance well into the future is an area of even more uncertainty.

Chapter 2.0 Introduction

In-Delta storage investigations were authorized under the CALFED Integrated Storage Investigations Program as defined in the CALFED Bay-Delta Program Programmatic Record of Decision (ROD) and Implementation Memorandum of Understanding (MOU) signed on August 28, 2000, by State and Federal agencies (collectively, the CALFED Agencies). The ROD identified in-Delta storage as one of five surface storage projects (Shasta, Los Vaqueros, In-Delta, Sites Reservoir, and 250-700 thousand acre feet (TAF) of additional storage in the upper San Joaquin River watershed). As a part of the In-Delta Storage Investigations, CALFED Agencies also decided to explore the lease or purchase of the Delta Wetlands (DW) Project, a private proposal by DW Properties Inc. to develop and market a water storage facility in the Sacramento-San Joaquin Delta (Delta). The ROD included an option to initiate a new project if the DW Project proved cost prohibitive or technically infeasible.

The Department of Water Resources and the CALFED Bay-Delta Program, with technical assistance by the U.S. Bureau of Reclamation (Reclamation), conducted a joint planning study in 2001 to evaluate the DW Project and other in-Delta storage options' ability to contribute to CALFED water supply reliability and ecosystem restoration objectives. The study consisted of six technical and financial feasibility evaluations of the DW Project: water supply reliability, impacts on water quality, engineering feasibility, environmental impacts, economic justification, and policy and legal. The main purpose of the investigations was to determine if the DW proposed project was technically and financially feasible. Information from the evaluations were presented in the In-Delta Storage Program Planning Study Summary Report (CALFED 2002a) and supporting technical documents available at http://www.isi.water.ca.gov/ssi/indelta/reports.shtml.

Based on the evaluations done through engineering, operations, water quality, environmental and economic studies, and engineering design review by the Independent Board of Consultants, DWR and Reclamation concluded that the project concepts as proposed by DW were generally well planned. However, it was the conclusion of DWR and Reclamation that for ownership by these two agencies, the project as proposed by DW required modifications and additional analyses before it was appropriate to "initiate negotiation with Delta Wetlands owners or other appropriate landowners for acquisition of necessary property" (CALFED ROD, page 44).

In 2002, DWR staff initiated additional evaluations of the modified DW Project, now referred to as the In-Delta Storage Project. The environmental evaluations were based on the recommendations made in the In-Delta Storage Program Planning Study Report on Environmental Evaluations (CALFED 2002b), and were focused in the following resource areas: land use, botanical, wildlife, cultural, aquatic, hazardous materials, and recreation. This report presents the results from the 2002-2003 environmental evaluations and makes recommendations for future work.

Chapter 3.0 Land Use

Background

In the In-Delta Storage Program Planning Study Report on Environmental Evaluations (CALFED 2002), DWR staff presented the following information:

- Summarized land use information from the Draft Environmental Impact Report (DEIR) and Draft Environmental Impact Statement (DEIS) for the DW Project (JSA 1995A), and Final EIS (JSA 2001a);
- Updated land use information based on DWR Land Use Survey Data from 1995 and 1996; and
- Recommended additional evaluations to develop land use mitigation to minimize impacts to agricultural land.

As mentioned previously, the In-Delta Storage Program is one of five surface storage projects identified in the CALFED ROD. The ROD contains 14 Implementation Commitments that all CALFED programs must incorporate into their program's implementation. One of the Implementation Commitments focuses on land acquisition. The Land Acquisition Implementation Commitment states, "Successful implementation of the CALFED Program will affect some agricultural lands. As an important feature of the State's environment and economy, agricultural lands will be preserved during the implementation of the Program in a manner consistent with meeting program goals, minimizing impacts to agriculture."

The ROD also contains a list of 31 mitigation measures that will reduce potential effects of implementing CALFED projects on agricultural land. The mitigation measures are to be used during project-specific planning and should be considered and adopted where feasible when conducting second-tier environmental review[1].

JSA (2001a) identified two significant adverse impacts to agricultural land from the DW Project: conversion of prime farmland and conflicts with land use plans and policies. DW Project did not propose mitigation measures to reduce the impacts on agricultural lands to less than significant levels. The SWRCB issued a Statement of Overriding Considerations in D-1643 and considered the project's value to water supply to outweigh the importance of maintaining agriculture on the islands. In the 2001-2002 Planning Study, DWR staff suggested that some level of mitigation for agricultural impacts be included in the project in order to be consistent with the commitments in the CALFED ROD.

DWR staff recommended the following steps be taken in the 2002-2003 land use evaluations:

- Evaluate the use of agricultural easements on surrounding agricultural lands as mitigation by working with Department of Conservation, San Joaquin County, DPC, and Contra Costa County to identify suitable agricultural land and quantities for easements; developing costs for agricultural easements; and, determining specific easement locations compatible with CALFED agencies goals.
- Evaluate the use of Sherman or Twitchell islands for wildlife and wetland mitigation.
- Work with Department of Conservation and other CALFED agencies to resolve any remaining Williamson Act issues.

This section presents the outcome of the 2002-2003 land use evaluations.

Methods

DWR staff completed a Land Evaluation and Site Assessment (LESA) in order to quantify the impacts of the In-Delta Storage Program on agricultural land. The LESA evaluation was completed according to procedures outlined in DOC (1997). The LESA is an optional model lead agencies can use when assessing impacts on agriculture and farmland (Bass and others 1999). The LESA was completed for Webb Tract and Bacon Islands only. We assumed that the conversion of Webb Tract and Bacon Islands from agriculture to reservoir storage would be a permanent conversion by the State of California and/or the federal government. We did not complete a LESA evaluation for Bouldin Island and Holland Tract because the Habitat Management Plan for these islands is currently being revised and the loss of agriculture is unclear. (See Chapter 5.0 for information on the proposed management of Bouldin Island and Holland Tract.)

DWR staff reviewed the Contra Costa County General Plan, San Joaquin County General Plan, Sacramento County General Plan, and contacted the San Joaquin County Planning Department, Sacramento County Environmental Assessment, and the Contra Costa Community Development Department for guidance in setting significance levels and for determining appropriate mitigation ratios. (Webb Tract is located in Contra Costa County and Bacon Island is located in San Joaquin County.)

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[1] The second-tier environmental review for the In-Delta Storage Program is the Subsequent EIR/EIS. If the agencies decide to move forward with the In-Delta Storage Program, work on the Subsequent EIR/EIS is

To determine the feasibility of using agricultural easements for land use mitigation, we contacted the DOC and the Delta Protection Commission (DPC) to obtain information on known areas in the Delta with existing agricultural or conservation easements. The potential costs of agricultural easements were obtained from an environmental organization involved in conservation in the Sacramento-San Joaquin Delta and the East Contra Costa County Habitat Conservation Plan Association.

Results

LESA

The LESA evaluation resulted in a score of 59 for Bacon Island and a score of 55 for Webb Tract. The project's conversion of Bacon Island and Webb Tract from agriculture to reservoir storage is a significant impact according to the CA LESA Model Scoring Thresholds (DOC 1997). The worksheets from the LESA evaluation are in Appendix A.

Significance Thresholds and Mitigation Ratios

The San Joaquin County General Plan lists preserving agricultural land and protecting natural resources as one of its basic values (SJC 2000). San Joaquin County has not established specific mitigation ratios for conversions of agricultural land to nonagricultural uses (Hulse 2003 personal communication; see "Notes"). The mitigation required by San Joaquin County has varied depending on the project location, the type of project and the project size (Hulse 2003 personal communication; see "Notes").

The Contra Costa County General Plan principles include encouraging and enhancing agriculture, and maintaining and promoting a healthy and competitive agricultural economy (CCC 1996). Contra Costa County uses LESA evaluations to determine the significance of agricultural land conversions to urban uses. Mitigation ratios are decided on a case by case basis (Roch 2003 personal communication; see "Notes").

Land conversions within Contra Costa County are subject to a land preservation ordinance, Measure C 1990. Measure C 1990 requires that 65% of county land remain in non-urban use. Non-urban use is defined as rural residences, agricultural structures, public facilities necessary for public welfare, etc. In-Delta Storage would fall under the non-urban use classification. However, since the land will be submerged as a reservoir, we would be removing Webb Tract from the total land in the County and the 65/35 ratio would be unaffected.

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expected to begin in Fiscal Year 2003-2004.

The East Contra Costa County Habitat Conservation Plan Association is developing a Habitat Conservation Plan (HCP) for Eastern Contra Costa County. The HCP will not extend into the legal Delta. The ECCHCPA has not developed a specific mitigation ratio for agricultural land conversions. Millions of local dollars are being set aside for obtaining agricultural easements in Contra Costa County (Kopchick 2003 personal communication; see "Notes"). If In-Delta Storage Project were to use agricultural easements for land use mitigation, it would be consistent with the County's plans and local interest.

Respectively, Sacramento and Yolo counties have established significance thresholds and mitigation ratios for conversions of agricultural lands to other uses. While none of the In-Delta Storage Project islands are within Sacramento or Yolo counties, the thresholds and ratios can be used as a guide for establish mitigation for In-Delta Storage Project. The Sacramento General Plan sets a significance standard of 50 acres for conversions of agricultural land to other uses (Hack 2003 personal communication; see "Notes"). Sacramento County has not established a standard mitigation ratio or mitigation fees for impacts to agricultural land at this point. However, Sacramento County did require a 1:1 mitigation ratio for conversions of agricultural land to urban uses in the East Franklin Specific Plan Final Environmental Impact Report (SAC 2000). The project proponent protected an equal amount of agricultural land located within a 3 miles radius of the project site in a conservation easement.

Yolo County zoning code requires a 1:1 mitigation ratio for changes from an Agricultural Zoning Classification to a Non-Agricultural Zoning Classifications (Yolo 2003). The zoning code also defines conservation easements, farmland deed restrictions, or other farmland conservation mechanisms as suitable mitigation. Lands identified as mitigation must meet specific criteria including:

- Have soil quality comparable to impacted land,
- Have an adequate water supply, and
- Be located within Yolo County either within a two mile radius of the impacted land or outside the two miles radius depending on certain requirements.

Easement Locations and Potential Costs

DPC reported that 11,717 acres in the Delta Primary Zone were in conservation easements in 2002, or about 2% of the legal Delta (Aramburu 2003). Figure 3-1 shows the lands that are currently owned by DFG, in fee title, or in conservation easements for wildlife management. In 2002, conservation easements near the In-Delta Storage Project islands were found on Holland

Tract[2], Medford Island, Mandeville Island, Palm Tract, Tyler Island, Terminous Tract, Empire Tract, and Jersey Island (Aramburu 2003). Similar information from Contra Costa County and San Joaquin County was not available at the time of this report. Over 16,000 acres of agricultural land are in production in the Delta portion of Contra Costa County (Jersey, Bradford, Quimby Island, Webb, Orwood, Webb, Byron, Holland and Veale Tracts) (Aramburu 2001). Over 253,000 acres of agricultural land are in production in the San Joaquin County portion of the Delta (DPC 1994). Based on this information, it should be possible to obtain agricultural easements on land surrounding the In-Delta Storage Project islands.

The cost of agricultural easements in the Delta is around $1200/acre. The Nature Conservancy has purchased easements in San Joaquin County portion of the Delta, and those easements have averaged $1200/acre (Unkel 2003 personal communication; see "Notes").

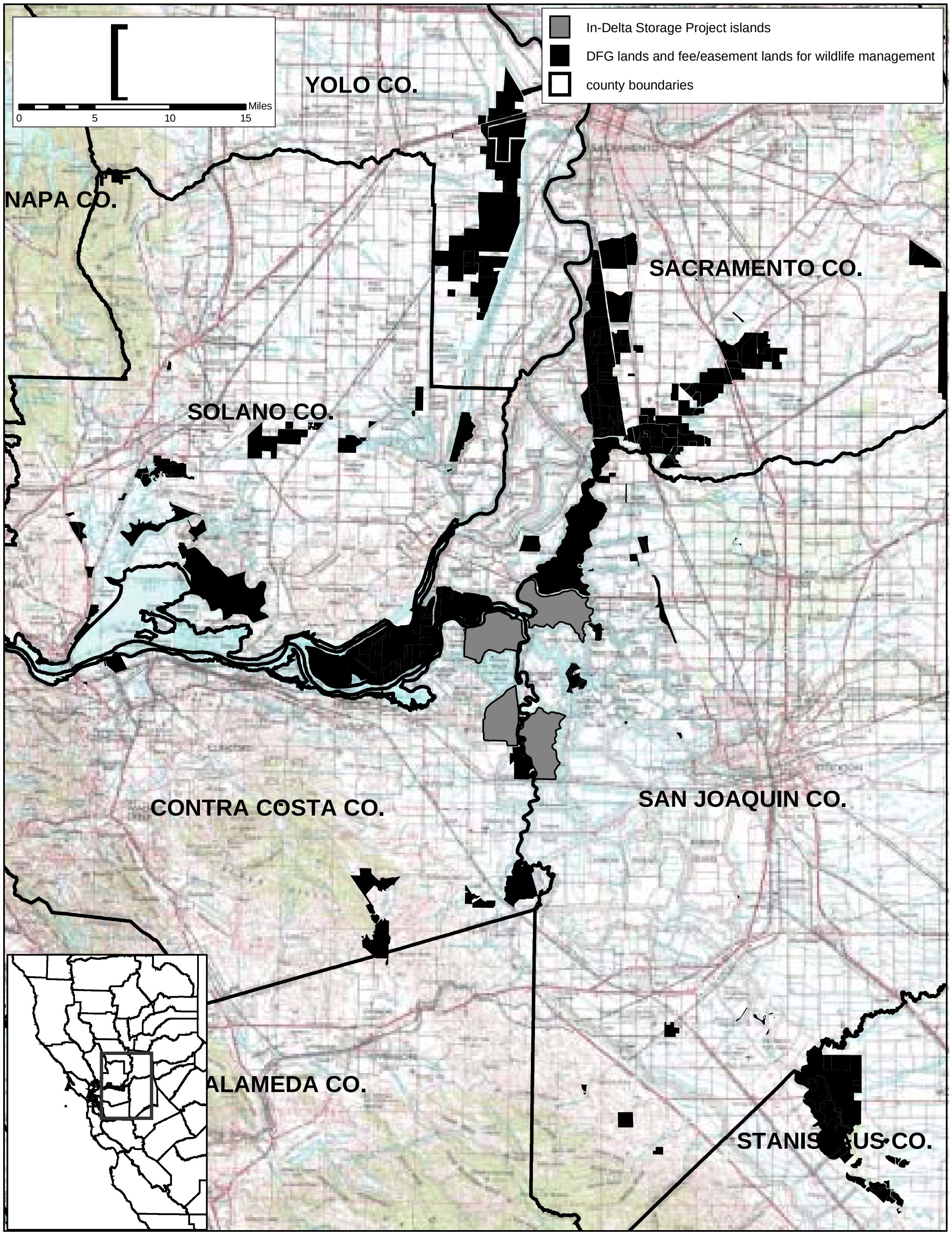


Figure 3-1. Lands owned by DFG, in fee title, or in conservation easements for wildlife management (Clamurro 2003 personal communication; see "Notes")

Discussion

During the 2002 public review and CALFED Science review periods, DWR staff received conflicting comments on the impacts of the project to agricultural land and the need for mitigation. For example, some reviewers identified potential impacts to agricultural land not previously evaluated. Others disagreed with the statement that the project does not include mitigation to minimize impacts for conversion of agricultural land. While others indicated that no mitigation was needed.

Because of the differences in opinion on whether there are impacts to agricultural land, DWR staff conducted a LESA evaluation of the project. Results from the evaluation indicated that conversion of Webb Tract and Bacon Island from agricultural uses will result in a significant impact to agricultural land. Significant impacts to agricultural land on Webb Tract and Bacon Island were previously identified by JSA (2001). Other impacts to agricultural land included[3]:

- The conversion of 4,725 acres of prime farmland on Webb Tract and 5,278 acres of prime farmland on Bacon Island to nonagricultural use is considered a significant impact under CEQA.
- The conversion of Webb Tract from agriculture to water storage conflicts with Contra Costa County's policy to encourage and enhance agriculture, and the DPC's policies that designate agriculture as the primary land use in the Delta.
- The conversion of Bacon Island from agriculture to water storage conflicts with the DPC's policies that designate agriculture as the primary land use in the Delta[4].

San Joaquin and Contra Costa counties have not established mitigation ratios for conversions of agricultural land to other uses. Sacramento County has required a 1:1 mitigation ratio for projects, and Yolo County zoning code specifies a 1:1 mitigation ratio. If In-Delta Storage were to provide mitigation for impacts to agricultural land at a 1:1 ratio, over $12 Million would be required for the easements. CEQA does not require projects to adopt mitigation measures that are infeasible (Guidelines section 15091(a)(3)). When the cost of the mitigation measure would make the project infeasible, "…the agency must support the finding with specific data showing that the additional cost or lost profits are great enough to make it impractical to proceed with the project." (Bass and others 1999). Additional analysis will be necessary in Fiscal

[3] Impacts to Williamson Act lands are addressed in a subsequent section.
[4] DPC land use plan recommends that water reservoirs that are consistent with other uses in the Delta be permitted (1995). Recommendations are "additional, optional directions for actions for local government, for non-profit groups, State agencies, and others."

Year 2004 to determine whether spending $12 Million for agricultural easements is feasible for the project.

The following priorities can be used when obtaining agricultural easements for the project:

- Obtain agricultural easements in the Delta portion of San Joaquin and Contra Costa counties,
- Obtain agricultural easements any where in the legal Delta,
- Obtain agricultural easements in San Joaquin and Contra Costa counties outside of the legal Delta.

CALFED (2000) provided mitigation strategies to minimize adverse impacts on agriculture, including focusing easement acquisition on lands in proximity to the impacted area. Higher priority was given to easements within the legal Delta than easements outside the Delta because the problem area identified by CALFED is the legal Delta, Suisun Marsh and Suisun Bay (CALFED 2000). Obtaining agricultural easements outside the legal Delta but within San Joaquin and Contra Costa counties was given lower priority because it was assumed that the land would be further from the affected islands but still within the range of the solution area identified by CALFED.

Additional work should be done to identify potential land for the easements. CALFED's ERP has targeted up to 111,000 acres of Delta land for restoration. Work should be coordinated with ERP to minimize conflicts between the ecological visions for the Central and West Delta Management Zone, the Delta Region, and potential easement locations.

Several possible partnerships could be developed to assist in identifying suitable easement locations. The first partnership could be with the Farmland Conservancy Program. The DOC is developing a mechanism for CALFED agencies to use the Farmland Conservancy Program as a type of mitigation bank. A second option involves partnering with local agencies. The Contra Costa County Agricultural Land Trust is the county arm that implements agricultural easements in Contra Costa County. The Brentwood Land Trust is a private entity that could provide similar assistance. Partnerships with local agencies could facilitate property identification and communication with landowners.

San Joaquin County Ordinance

In June 2002, San Joaquin County adopted a land use ordinance as part of its zoning codes. The ordinance requires that project proponents obtain a use permit before constructing a water storage project of greater than six feet in depth, for storage of 30 days or more in any calendar year, on 500 acres or more of agricultural land in the County. The Delta Wetlands Properties

(DWP), a private enterprise, would be required to apply for such a use permit if it were to construct the Delta Wetlands Project on Bacon Island in the Sacramento-San Joaquin Delta. In January 2002, DWP sued the County in superior Court of California, seeking to have the Court set aside the ordinance. In January 2003, the Court ruled against DWP and found the ordinance valid. DWP filed an appeal of the ruling.

Although the ordinance may affect DWP if it proposes to construct the DW Project, it would not affect DWR or Reclamation's construction of the In-Delta Storage Project. San Joaquin County is organized under the State general law and the County only has those powers granted to it by the legislature. The County must comply with State law unless a statute expressly authorizes control by the County over specific areas. The State generally leaves local land-use control to local rule. However, State law preempts local law when local law duplicates, contradicts, or enters an area fully occupied by general law, either expressly or by legislative implication.

Here, the ordinance to control development of water storage facilities in the Delta enters an area that State law has fully occupied through enactment of the Central Valley Project Act (Water Code Section 11100 et seq.) and the California Water Resources Development Bond Act (Water Codes 12930 et seq.). Under these Acts, DWR has specific authority to construct facilities it determines necessary and desirable to augment water supplies for the State Water Resources Development System, including facilities in the Delta (Water Code Sections 12931 and 12938). Even though local government is not precluded from coordinating efforts with the State, the State's water-needs preempt local laws if the laws conflict. Therefore, in this case, State law fully occupies the area of legislation that the County ordinance affects and DWR is not subject to the ordinance.

Williamson Act Requirements

The California Land Conservation Act of 1965, generally referred to as the Williamson Act, provides for establishment of agricultural preserves through contract between landowners and local government (Government Code Section 51200 et seq.). Under the Act, private landowners may voluntarily restrict their land to agricultural and compatible open-space uses by entering into minimum 10-year rolling term contracts with the county or city that has jurisdiction over the land. In return, restricted parcels are assessed for property taxes at a rate consistent with actual use, rather than potential market value. Williamson Act contracts are automatically renewed every year unless nonrenewed. The Act describes steps that must be followed in order to cancel a contract. The purpose of the Act is to preserve agricultural and open space lands by discouraging premature and unnecessary conversion to urban uses (DOC 2001).

Webb Tract contains a 139-acre parcel that is under Williamson Act contract. Approximately 4,662 acres of Bacon Island are currently under Williamson Act contracts (JSA 1995A). Public agencies, such as DWR or Reclamation, may acquire land that is under Williamson Act contract when the agency needs to locate a public improvement on the land (Gov. Code Section 51291). Public improvements are defined by the Act and include facilities or interests in real property owned by a public agency. If DWR or Reclamation were to acquire the Delta Wetlands Project for its use, it would be considered a public improvement under the Act. The Act requires that public agencies satisfy specific notification requirements and make specific findings prior to locating a public improvement on such land. If DWR were to consider acquisition of the Delta Wetlands properties, it would need to notify the Director of the Department of Conservation and the local governing body responsible for the administration of the agricultural preserve of the intent to locate a public improvement on the land. The need to make the specified findings under the Act would depend on the use of the reservoirs constructed on the islands.

DWR staff met with Department of Conservation (DOC) staff to discuss the process required if DWR were to acquire these lands that are under Williamson Act contract. DOC staff confirmed that the flooding of Webb Tract and Bacon Island would not be considered a “compatible use” under Section 51293 of the Act as flooding of the islands would not be compatible with or enhance land within the agricultural preserve. Therefore, DWR would need to provide notice and make specified findings before acquiring the Williamson Act land for the water-storage project.

If DWR constructs the water-storage project for the State Water Project, it could be considered a State Water Facility and DWR would be exempt from the requirement to make specified findings prior to locating the project on Williamson Act lands. The Act exempts certain types of projects from the requirement of making findings under Section 51292. Specifically, the Act exempts State Water Facilities, except those constructed for local agencies under the Davis-Grunsky Act (Section 51293(h)). A State Water Facility is defined as “master levees, control structures, channel improvements, and appurtenant facilities in the Sacramento-San Joaquin Delta for water conservation, water supply in the Delta, transfer of water across the Delta, flood and salinity control, and related functions” (Water Code Section 12934(d)(3)). The In-Delta Storage Project that DWR could construct could be for these purposes and would meet the definition. However, if the exemption of Section 51293(h) did not apply, DWR would most likely be able to make the necessary findings required by the Act, specifically: that the location of the public improvement is not based primarily on a consideration of the lower cost of acquiring land in an agricultural preserve, and that there is no other land within or outside the preserve on which it is reasonably feasible to locate the public improvement (Section 51292).

As mentioned above, prior to possible acquisition of Williamson Act lands for a public improvement, DWR would provide the following information to the Director of DOC and the local governing body:

- The total number of acres of Williamson Act contract land to be acquired and whether the land is considered prime agricultural land according to Gov. Code Section 51201.
- The purpose of the acquisition and why the land was identified for acquisition.
- A description of where the parcels are located.
- Characteristics of adjacent land (e.g., urban development, Williamson Act, agricultural land.)
- A vicinity map and a location map.
- A copy of the contracts covering the land.
- CEQA documents for the project.
- The findings required under Gov. Code Section 51292, documentation to support the findings and an explanation of the preliminary consideration of Gov. Code Section 51292 (unless the facilities are exempted).

If DWR were to proceed with actual acquisition of the land, it must notify the Director of DOC of the acquisition and include an explanation of the decision to acquire the land, the findings made under Section 51292, if required, and if information is different from that provided in the prior notice.

Recommendations

- Determine the implications of acquiring 10,003 acres of agricultural easements on the financial feasibility of the In-Delta Storage Project and the implementation of ERP actions in the Delta.
- Develop the information required of state agencies under the Williamson Act (notice and findings).
- Continue discussions on agricultural mitigation options with the DPC, DOC, Contra Costa County and San Joaquin County.

Chapter 4.0 Special Status Plant Surveys

Introduction

Delta Wetland's consultants carried out surveys for special status plant species in 1988. Because these surveys were fourteen years old, we determined that additional surveys were needed in order to detect any new populations of sensitive plants and to document occurrences of species that were not designated as special status species at the time of the previous surveys. Based on recommendations from DFG and USFWS, areas along the facing side of in-channel islands adjacent to the study island (not included in the original studies) were added to the survey area. These were areas that might be impacted due to increased recreational boat traffic.

Methods

Determining target species list

A list of special-status species was created from two sources, the California Natural Diversity Database and the US Fish and Wildlife Service, based on USGS quad boundaries. Any species included in the CNDDB that has a record of occurring in the USGS quadrangles encompassing the project were included on the list. The USFWS list was incorporated into the list. The CNPS database of Rare and Endangered Plants of California was also queried at the quad level, and any species that were found in that database were added as well.

The resulting list was reviewed in consultation with USFWS and DFG personnel, and some species were eliminated due to the lack of suitable habitat on the DW islands. These were species that are known to occur on alkaline clay soils or in vernal pool habitats; neither of these habitats is found on the islands. The result was a conservative list of sensitive species, including CNPS list 4 species that are not covered under CEQA (Table 4-1).

Timing of surveys

Many plant species can only be positively identified with flowers. Botanical surveys were scheduled so that the target species would be in flower when staff was searching for them. The CNPS database provides flowering times, which dictated the schedule. The species on our list fell into two distinct flowering periods that required multiple visits: early summer vs. late summer/fall (Table 4-1).

Table 4-1. Special Status Plant Species Potentially Occurring within the Proximity of the Project Area

Scientific name Common name Family	Status* Fed./State CNPS	Distribution in California	Habitat and flowering time
Aster lentus Suisun marsh aster Asteraceae – sunflower family	FSC/-- 1B	San Francisco, San Pablo, and Suisun Bays and the Delta. Counties: Contra Costa, Napa, Sacramento, San Joaquin, Solano	Salt, brackish and freshwater marshes at or above the zone of tidal fluctuation. Elev. <150 m. Blooms May – Nov.
Carex comosa Bristly sedge Cyperaceae – sedge family	--/-- 2	Inner North Coast Ranges, Cascade Range, Great Valley, northern Central Coast, San Francisco Bay area, and elsewhere. Counties: Contra Costa, Lake, Mendocino, San Bernardino, Santa Cruz, San Francisco, Shasta, San Joaquin, Sonoma.	Coastal prairie, marshes and swamps (lake margins), valley and foothill grassland; elev. 0 – 425 m. Blooms May – Sept.
Carex vulpinoidea Fox sedge Cyperaceae – sedge family	--/-- 2	Southeastern Klamath Range, northern Cascade Range, northern Sacramento Valley, and elsewhere. Counties: Butte, Shasta, Siskiyou, Tehama, Trinity.	Marshes and swamps (freshwater), riparian woodland; elev. 30 – 1200 m. Blooms May – June.
Cirsium crassicaule Slough thistle Asteraceae – sunflower family	--/-- 1B	The Delta and San Joaquin Valley. Counties: Kings, Kern, San Joaquin.	Shallow water or saturated soils in chenopod scrub, marshes, swamps, and riparian scrub. Elev. 3 – 100 m. Blooms May – Aug.
Cryptantha hooveri Hoover's cryptantha Boraginaceae -- borage family	--/-- 1B	Northern and central San Joaquin Valley. Counties: Alameda, Contra Costa, Madera, Merced, San Joaquin, Stanislaus.	Sandy soils in valley or foothill grassland. Elev. < 150 m. Blooms Apr. – May.
Eleocharis parvula Small spikerush Cyperaceae – sedge family	--/-- 4	North Coast, Great Basin, Deserts and elsewhere. Counties: Butte, Contra Costa, Glenn, Humboldt, Napa, Orange, Siskiyou, San Luis Obispo, Sonoma, Ventura.	Wet, generally saline flats in marshes and swamps. Elev. < 2530 m. Blooms June – Sept.
Erysimum capitatum ssp. *angustatum* Contra Costa wall flower Brassicaceae – mustard family	FE/SE 1B	Known only from the Antioch Dunes in the city of Antioch, Contra Costa County.	Interior dunes with sparse herb and shrub cover. Elev. 3 – 20 m. Blooms Mar. – July.

Scientific name Common name Family	Status* Fed./State CNPS	Distribution in California	Habitat and flowering time
Gratiola heterosepala Bogg's Lake hedge-hyssop Scrophulariaceae – figwort family	--/SE 1B	Inner North Coast Ranges, central Sierra Nevada foothills, Sacramento Valley, Modoc Plateau, and elsewhere. Counties: Fresno, Lake, Lassen, Madera, Merced, Modoc, Placer, Sacramento, Shasta, Siskiyou, San Joaquin, Solano, Tehama.	Shallow water along the margins of lakes, marshes, swamps, and vernal pools. Often in clay. Elev. 10 – 2375 m. Blooms Apr. – Aug.
Hibiscus lasiocarpus Rose-mallow Malvaceae – mallow family	--/-- 2	Central and southern Sacramento Valley, deltaic Great Valley, and elsewhere. Counties: Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, Yolo.	Freshwater marsh, often in riparian areas with slow moving water. Canals, sloughs, ponds, and oxbow lakes. Elev. < 120 m. Blooms June – Sept.
Lathyrus jepsonii var. *jepsonii* Delta tule-pea Fabaceae -- pea family	FSC/-- 1B	The Delta and San Francisco Bay area. Counties: Alameda, Contra Costa, Napa, Sacramento, Santa Clara, San Joaquin, Solano.	River and canal banks in association with freshwater and brackish marshes and riparian woodlands at or above the zone of tidal influence. Elev. < 4 m. Blooms May – Sept.
Lilaeopsis masonii Mason's lilaeopsis Apiaceae – carrot family	FSC/SR 1B	The Suisun Bay and Delta. Counties: Contra Costa, Napa, Sacramento, San Joaquin, Solano.	On newly deposited or exposed sediments, wood pilings, or sometimes on levee riprap, within the tidal zone. Elev. < 10 m. Blooms Apr. – Nov.
Limosella subulata Delta mudwort Scrophulariaceae – figwort family	--/-- 2	The Delta and elsewhere. Counties: Contra Costa, Sacramento, San Joaquin, Solano.	Edges of riverbanks and sloughs in marsh vegetation, rooted within the zone of tidal fluctuation. Elev. < 3 m. Blooms May – Aug.
Oenothera deltoides ssp. *howellii* Antioch Dunes evening primrose Onagraceae – primrose family	FE/SE 1B	Known only from the Antioch Dunes in the city of Antioch and from Brannan Island. Counties: Contra Costa, Sacramento.	Interior bluffs and dunes with sparse herb and shrub cover. Elev. < 30 m. Blooms Mar. – Sept.
Potamogeton zosteriformis Eel-grass pondweed Potamogetonaceae – pondweed family	--/-- 2	Southern Inner North Coast Range, Great Valley, Modoc Plateau, and elsewhere. Counties: Contra Costa, Lake, Lassen, Modoc, Shasta.	Ponds, lakes, streams and marshes. Elev. < 1860 m. Blooms June – July.
Sagittaria sanfordii Sanford's arrowhead Alismataceae – arrowhead family	FSC/-- 1B	North Coast, Great Valley, and northern South Coast. Counties: Butte, Del Norte, Fresno, Kern, Merced, Orange, Sacramento, Shasta, San Joaquin, Tehama, Ventura.	Shallow freshwater marshes, ponds, sloughs, streams and ditches. Prefers silty or muddy substrate. Elev. < 610 m. Blooms May – Oct.

Scientific name Common name Family	Status* Fed./State CNPS	Distribution in California	Habitat and flowering time
Scutellaria galericulata Marsh skullcap Lamiaceae – mint family	--/-- 2	High Sierra Nevada, Modoc Plateau, and elsewhere. Counties: El Dorado, Lassen, Modoc, Nevada, Placer, Plumas, Shasta, San Joaquin, Siskiyou.	Meadows, marshes, and seeps (mesic) in lower montane coniferous forest. Occurrences in the Delta (SJ Co.) need further study. Elev. < 2100 m. Blooms June – Sept.
Scutellaria lateriflora Blue skullcap Lamiaceae – mint family	--/-- 2	Northern San Joaquin Valley, east of the Sierra Nevada, and elsewhere. Counties: Inyo, San Joaquin.	Mesic meadows, seeps, and freshwater marshes. Elev. < 500 m. blooms July – Sept.

*Listing status code definitions used by the California Native Plant Society (CNPS), the State of California (DFG), and the Federal Government (USFWS) to describe the degree of endangerment and the legal status of sensitive plant taxa:

CALIFORNIA NATIVE PLANT SOCIETY (CNPS) LISTS	STATE LISTING CODES	FEDERAL LISTING CODES
List 1A: Plants presumed extinct in California List 1B: Plants rare, threatened or endangered in California and elsewhere List 2: Plants rare, threatened or endangered in California, but more common elsewhere. List 3: Plants about which more information is needed. List 4: Plants of limited distribution – a watch list.	SE State listed, endangered ST State listed, threatened SR State listed, rare	FE Federally listed, endangered FT Federally listed, threatened PE Proposed for federal listing as endangered PT Proposed for federal listing as threatened FSC Federal species of concern (replaces old “candidate” categories C1, C2, C3c) C Federal candidate for listing

Survey methods

Botanical surveys covered two areas: island interiors that were surveyed on foot or by vehicle, and levee faces and in-channel islands that were surveyed by boat. All survey routes were recorded with a GPS unit or marked on field copies of aerial photographs and later transferred to the GIS database (Figure 4-1 and 4-2). Land surveys were conducted by personnel on foot in areas that were structurally or botanically diverse (such as riparian forests). A canoe was used to survey the marshes around the large ponds on Webb Tract. Surveys in highly disturbed areas that were easily accessible (and therefore were monotonously covered in dense weedy growth) were conducted from slow-moving vehicles.

Surveys of levee faces and in-channel islands were conducted by boat. A small boat with shallow draft was driven slowly along levees or islands while a botanist on-board examined the shoreline. Mason’s lilaeopsis and Delta mudwort occur in easily visible mudflats, so essentially all populations/stands were located. Each stand was examined at close range by the botanist to determine if Mason’s lilaeopsis or Delta mudwort was present. California hibiscus and Suisun marsh aster are obvious when in flower, and boat surveys for these species were conducted at a somewhat faster rate. All occurrences of special-status plants were marked with a GPS unit (Corvallis Microtechnology, March II model) by getting as close as possible to the stand. Additional data such as size of populations or patches were also recorded. In instances where a plant population was more or less continuous along the shoreline, the occurrence was recorded as a line rather than a point.

Field surveys were performed using floristic methods as recommended by DFG (2000). All plant species encountered were identified to the extent necessary to determine their rarity and listing status. A plant species list was compiled for all the islands (Appendix B).

Data management

GPS data recording plant locations and routes were differentially corrected using the GPS software, imported into an ArcView GIS file. The data in this form can be used to create maps or analyze spatial patterns in data. Special status plant occurrences and elderberry stands were mapped (Figures 4-3 through 4-6).

Levee modification evaluation

A survey of existing riprap was conducted by boat on February 5 and 12, 2003. We assumed that rock was present on a levee stretch if rock showed above the water line at the time of the surveys (between 10 am and 3 pm each day). We were unable to determine how far down the levee slope the rock extended during the surveys. However, DWR staff were told that existing rock extends a few feet below low tide level (Arrich 2003 personal communication; see “Notes”). To determine whether special status plants could be impacted by the addition of riprap, we compared maps of special status plant locations for Webb Tract and Bacon Island with maps showing areas of likely rock work.

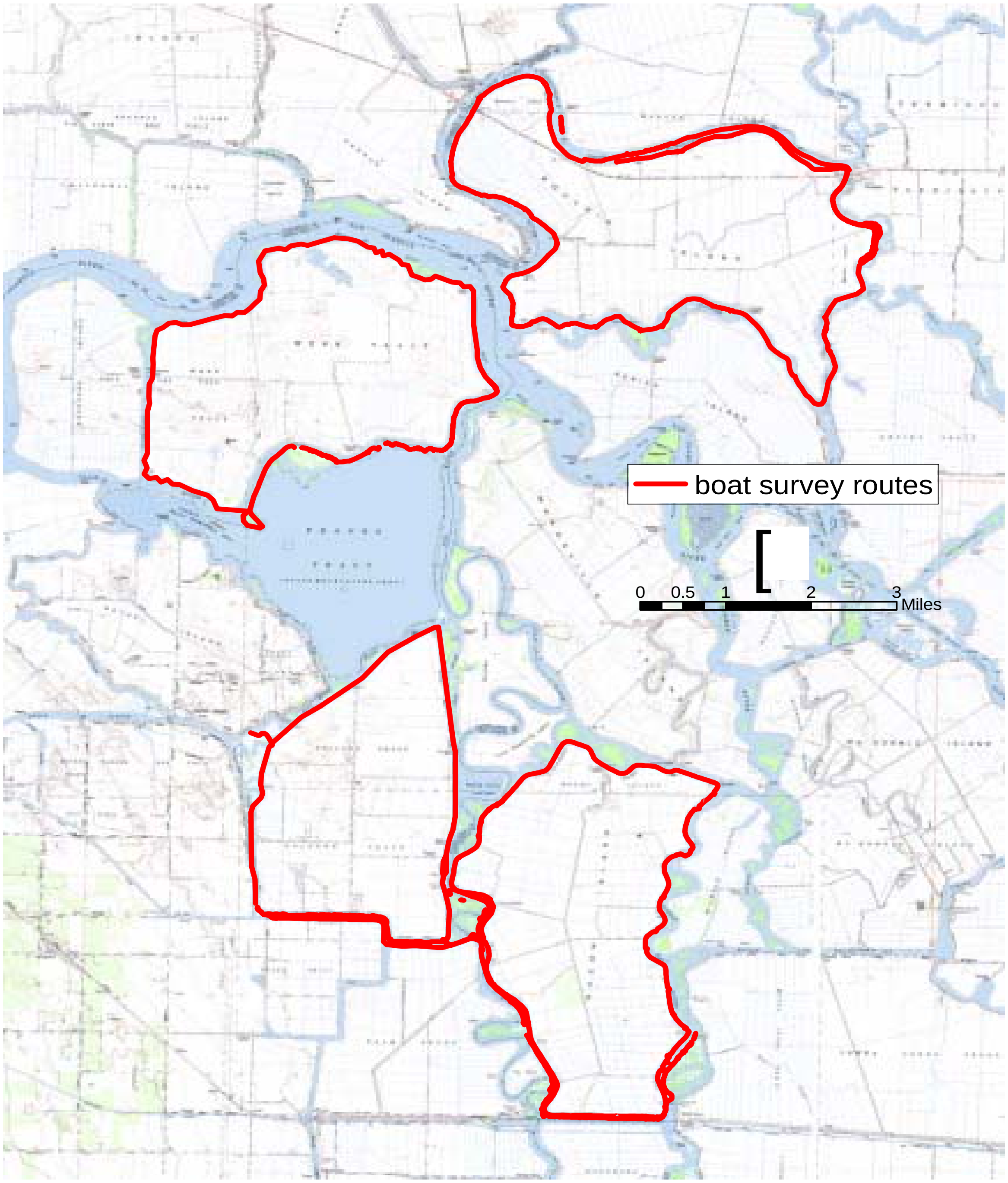


Figure 4-1. Boat survey routes for In-Delta Storage Project 2002 botanical surveys.

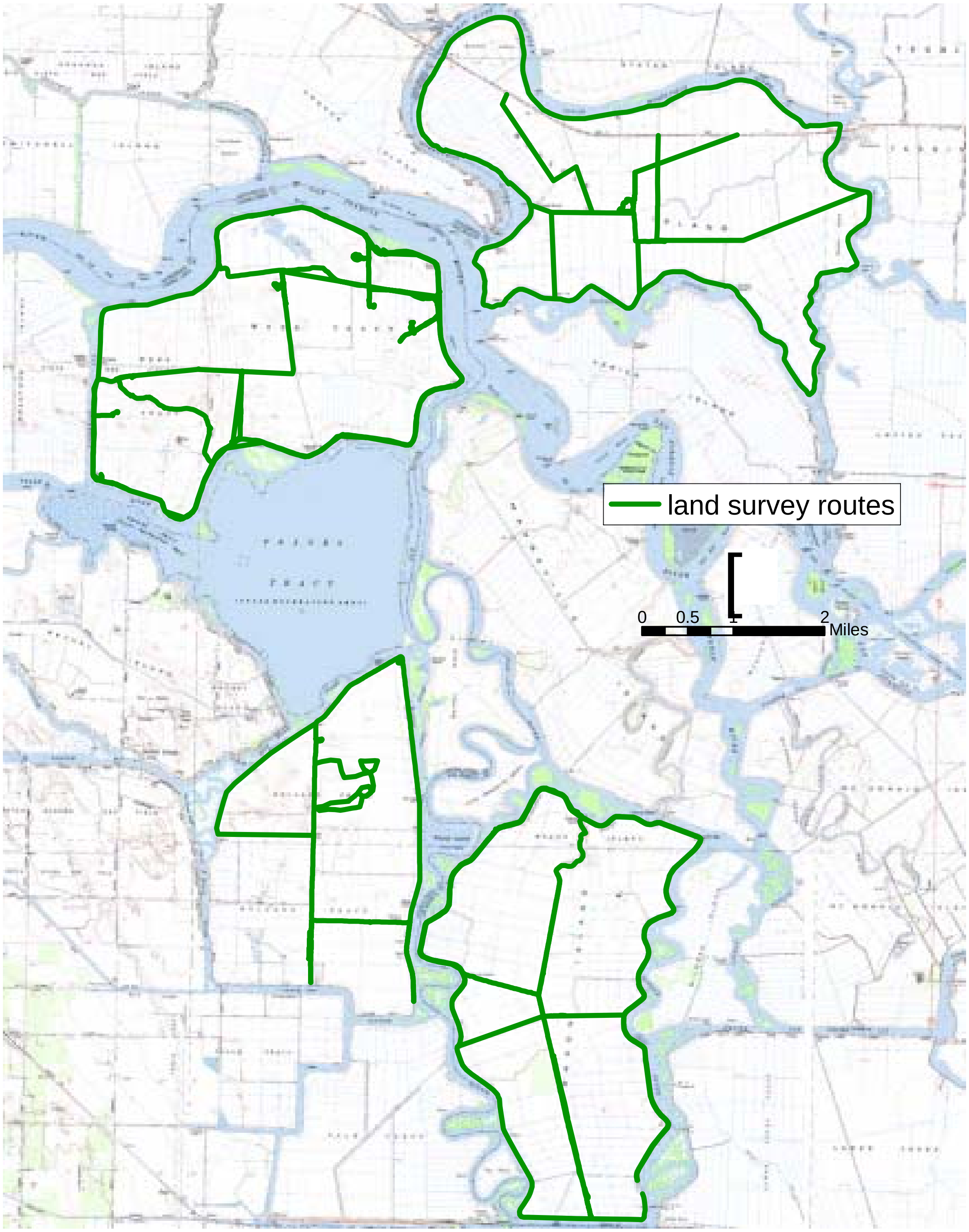


Figure 4-2. Land survey routes for 2002 In-Delta Storage Project botanical surveys.

Results

A total of 369 occurrences of six sensitive plant species and one occurrence of elderberry were located during field surveys in 2002. The sensitive species found were Delta mudwort (*Limosella subulata*), Delta tule-pea (*Lathyrus jepsonii* var. *jepsonii*), fox sedge (*Carex vulpinoidea*), Mason's lilaeopsis (*Lilaeopsis masonii*), rose-mallow (*Hibiscus lasiocarpus*), and Suisun aster (*Aster lentus*).

The majority of these occurrences (258, or 70%) were on in-channel islands adjacent to the main islands (Table 4-2).

Table 4-2. Populations of Special Status Plant Species Observed on or adjacent to Project Islands

Species (Fed/State/CNPS list)	Bacon		Webb		Holland		Bouldin		Total
	On island	Adjacent	On island	Adjacent	On island	Adjacent	On island	Adjacent	
Delta mudwort (--/--/2)	0	2	0	9	0	14	2	3	30
Delta tule-pea (FSC/--/1B)	0	0	1	0	0	1	0	0	2
Fox sedge (--/--/2)	1	0	0	0	0	0	0	0	1
Mason's lilaeopsis (FSC/SR/1B)	10	37	1	17	0	27	1	27	120
Rose-mallow (--/--/2)	13	28	2	8	1	56	2	3	113
Suisun Marsh aster (FSC/--/1B)	15	0	7	15	6	57	34	5	103

Blue Elderberry

Blue elderberry shrubs, while not in themselves considered sensitive, provide habitat for the Valley Elderberry Longhorn Beetle, a federally listed endangered species. One stand of elderberry was found during surveys of the islands, on Holland Tract (Figure 4-3).

Delta Mudwort

Delta mudwort is a CNPS list 2 species. Thirty occurrences of this species were found in 2002. Of these, 14 were on in-channel islands adjacent to Holland Tract, nine were adjacent to Webb Tract, 3 adjacent to Bouldin Island, and 2 adjacent to Bacon Island. Only 2 occurrences of this species were found on a study island proper; these were on Bouldin Island (Figures 4-3 through 4-6).

Delta Tule-pea

There were 2 occurrences of delta tule-pea documented during 2002 field surveys (Figures 4-3 through 4-6). This is a CNPS list 1B species. One was from Webb Tract proper, and another was on an in-channel island adjacent to Holland Tract.

Fox Sedge

Fox sedge is a CNPS list 2 species previously not known to occur in the Delta, and therefore it was not on the original target species list. The floristic survey method employed in this study allowed us to detect this new occurrence and apparent range extension for the species; however the single specimen found on Bacon Island probably represents an isolated occurrence (Figure 4-6). Lawrence Janeway at CSU Chico confirmed the species determination.

Mason's Lilaeopsis

Mason's lilaeopsis, a State-listed Rare species, was found at 120 separate locations within the study area, 108 of which were on adjacent in-channel islands (Figures 4-3 through 4-6). Bacon Island had ten occurrences of this species on the island proper, with an additional 37 occurrences on the adjacent in-channel islands. Bouldin Island had 27 occurrences of Mason's lilaeopsis on the adjacent in-channel islands, and one occurrence on the main island. There were 27 occurrences of the plant on in-channel islands adjacent to Holland Tract and none on the main island. Webb Tract in-channel islands supported 17 occurrences, and there was one occurrence on the main island.

Rose-mallow

Rose-mallow is a CNPS list 2 species. We documented 113 occurrences of this species on and around the study islands, mostly on in-channel islands (Figures 4-3 through 4-6). There were 56 occurrences adjacent to Holland Tract and 23 adjacent to Bacon Island, which also had 13 occurrences on the main island. One occurrence was on the main Holland Tract island. Bouldin Island had 3 occurrences adjacent to the island and 2 on it. Webb Tract had 8 occurrences adjacent to the island and 2 on it.

Suisun Aster

There were 103 occurrences of this CNPS list 1B species located within the study area (Figures 4-3 through 4-6). In contrast to most of the other sensitive plant species encountered, this one was more common on the main islands than on the in-channel islands, usually growing in the riprap on the outer levee slope. There were 34 occurrences on Bouldin Island, 21 on Holland Tract, 15 on Bacon Island, and 7 on Webb Tract. The in-channel islands adjacent to Webb Tract supported 15 occurrences; there were 6 adjacent to Holland Tract and 5 adjacent to Bouldin Island.

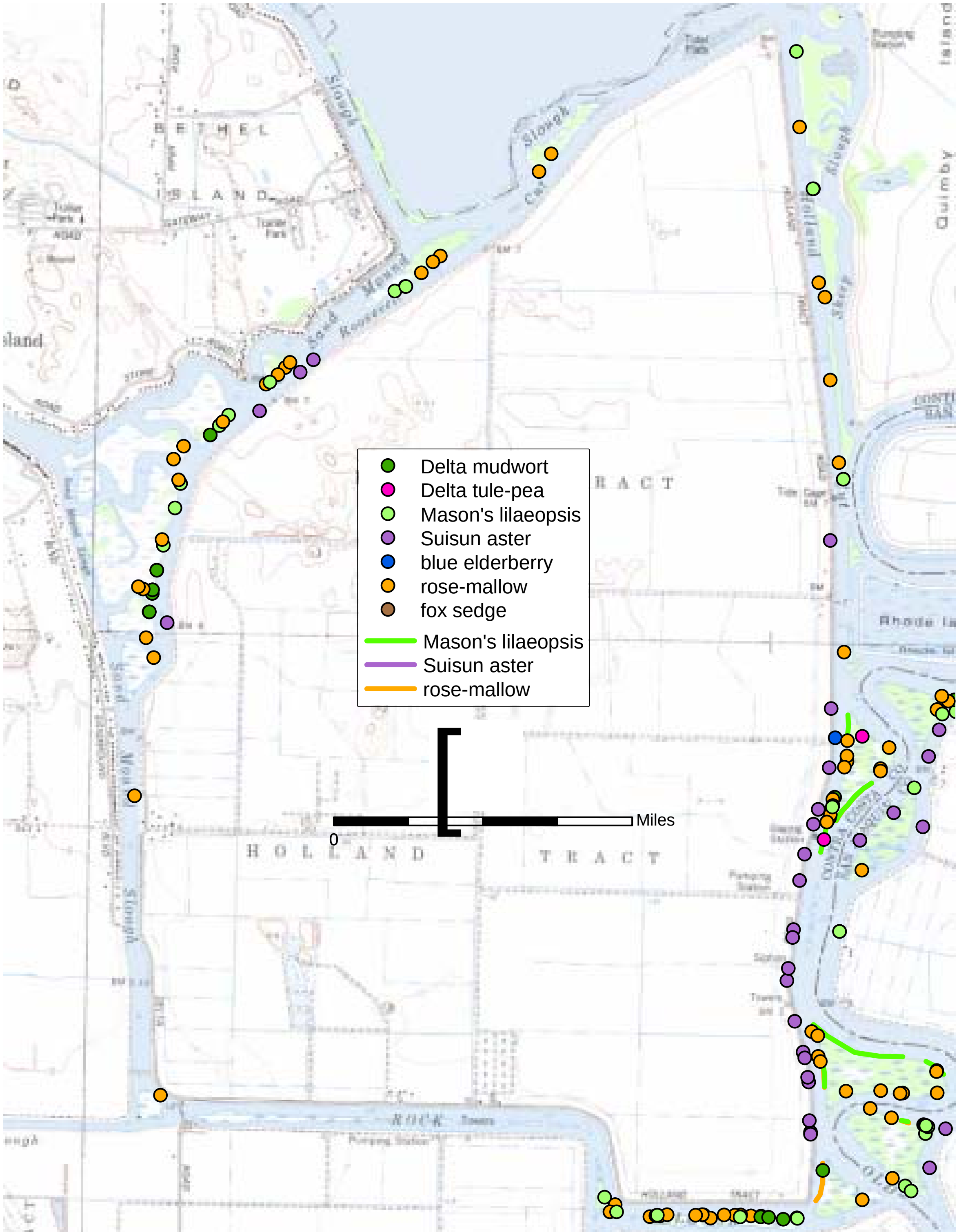


Figure 4-3. Special status plant species found on or adjacent to Holland Tract in 2002.

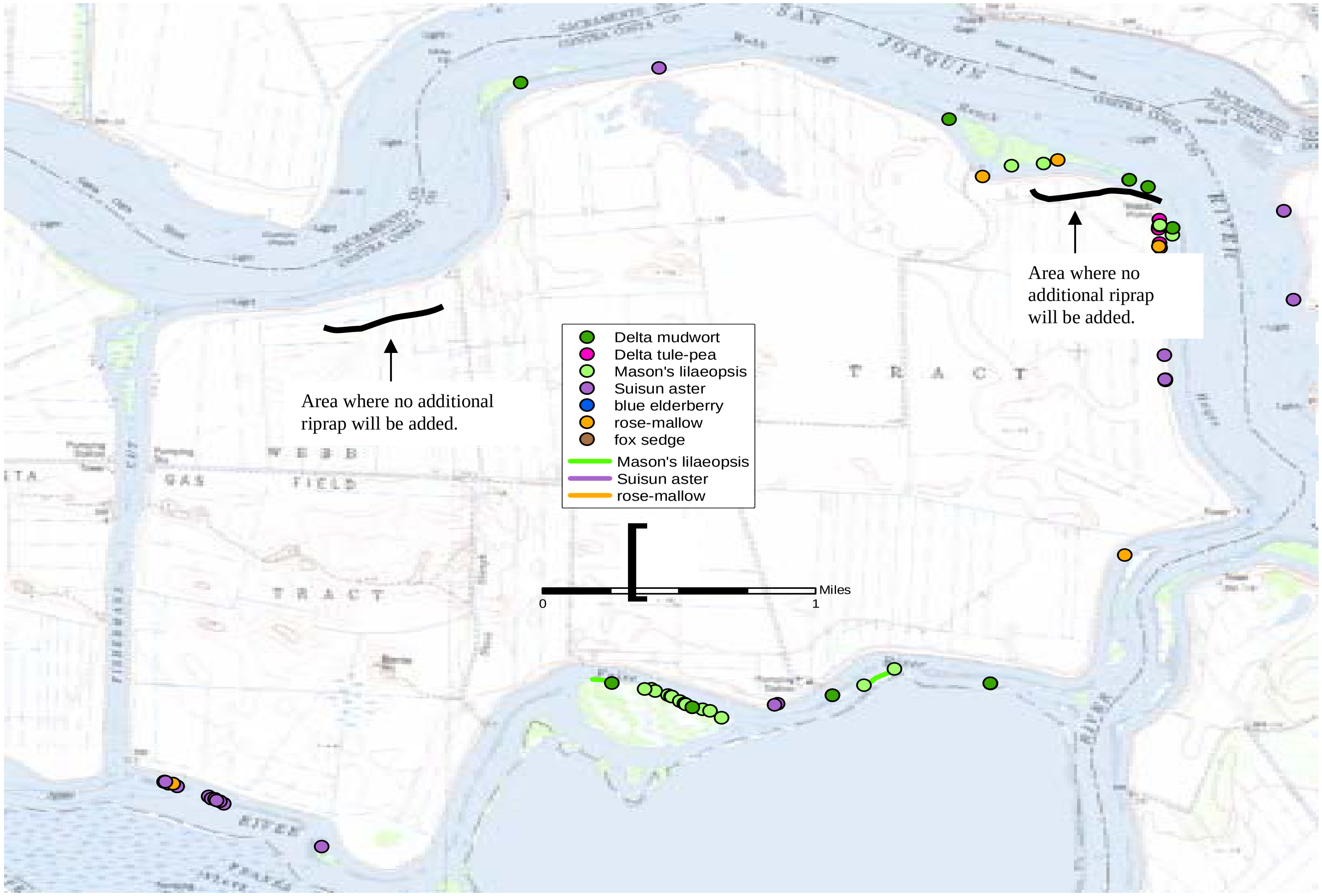


Figure 4-4. Special status plants found on or adjacent to Webb Tract in 2002.

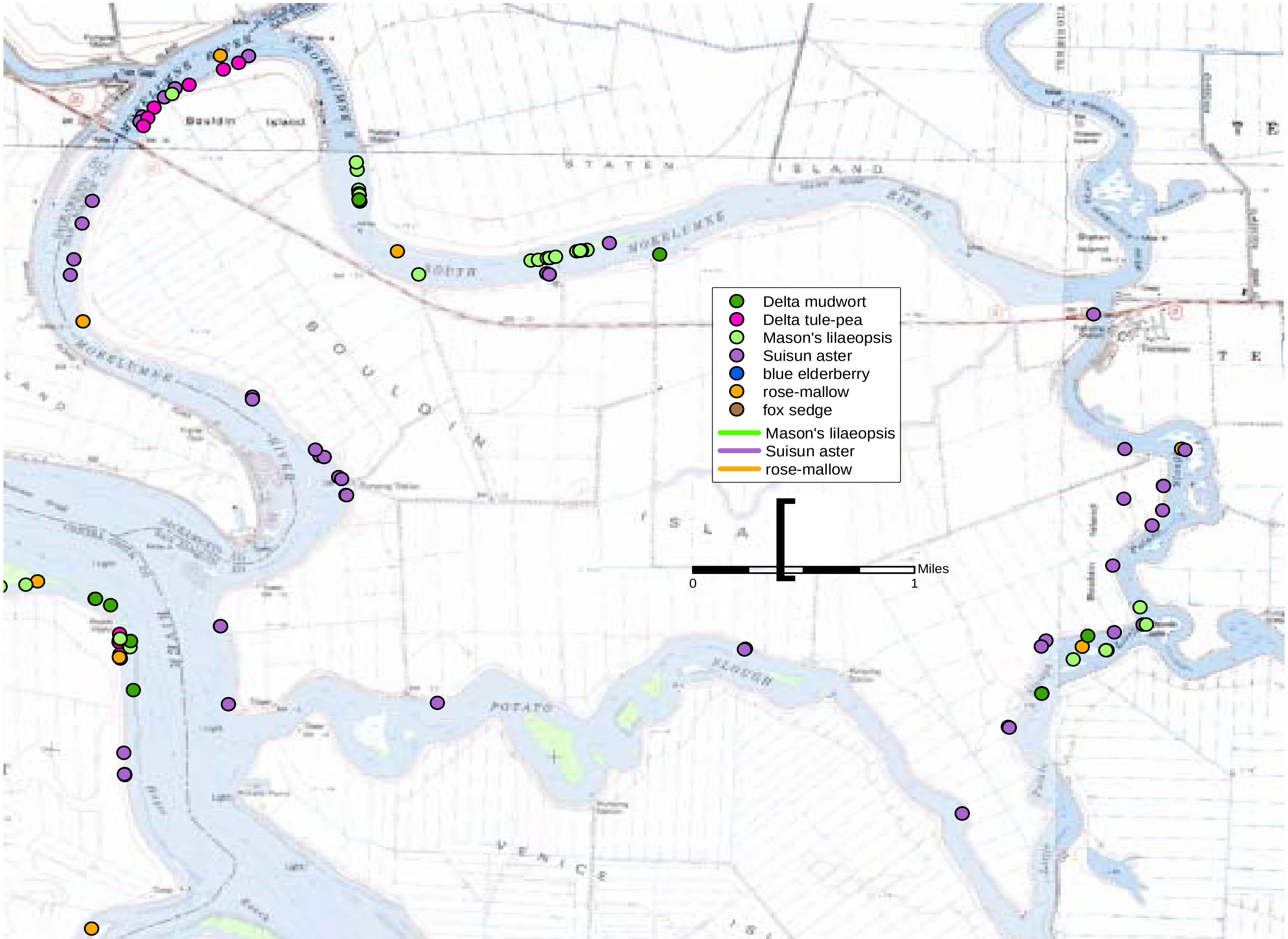


Figure 4-5. Special status plants found on or adjacent to Bouldin Island in 2002.

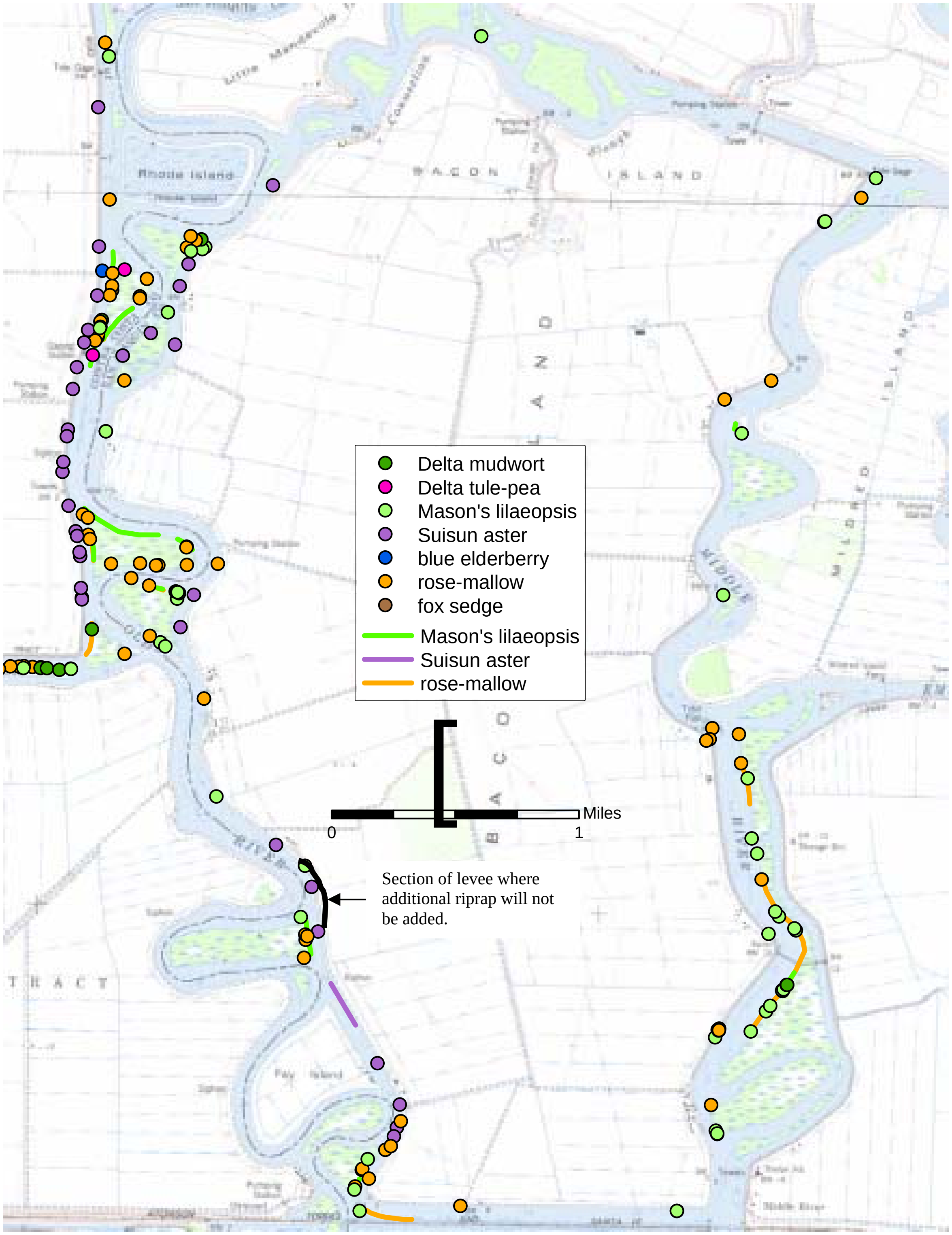


Figure 4-6. Special status plants found on or adjacent to Bacon Island in 2002

Discussion

Previous studies comparison

Previous plant surveys conducted on the Project islands did not include in-channel islands, where the majority of sensitive species occurrences were recorded in this survey. Comparing the main islands only, the occurrences found in the current study show an apparent increase in the population of Suisun Marsh Aster: from 6 to 15 occurrences on Bacon, 3 to 7 on Webb, 19 to 21 on Holland, and 8 to 34 on Bouldin. This species is frequently found growing within the riprap on the channel side of levees, and probably the populations fluctuate in response to levee maintenance activities.

The numbers of occurrences of rose-mallow in this study are similar or slightly more frequent on all the islands compared to the previous study. There were 13 occurrences on Bacon Island vs. 10 found previously; 2 on Webb Tract vs. 1 previous occurrence; likewise 2 on Bouldin vs. 1 found in the earlier study, and 1 on Holland Tract in both studies. Delta tule pea was about as abundant as in the previous study, with 1 occurrence on Webb (vs. 1 previously) and 1 on an in-channel island adjacent to Holland Tract. The single occurrence listed on Bouldin Island in the previous study was not documented in the current study. Fewer occurrences of Mason’s lilaeopsis were found than in the previous study, with only 10 on Bacon (18 previously), 1 on Webb (3 previously) and 1 on Bouldin (5 previously). The apparent decline in Mason’s lilaeopsis may be due to the transient nature of the habitat occupied by this species. It occupies mud banks and flats within the tidal zone that are subject to erosion and deposition of sediments, as well as various natural and man-made disturbances.

Delta mudwort was found in 2 locations on Bouldin Island in the present study, but was not found in the previous study. It occupies habitats similar to those where Mason’s lilaeopsis is found, and its populations may fluctuate due to the transient habitat. Fox sedge was found in only one occurrence in the present study, and probably represents an isolated establishment in the Delta of a species that is known to be more common elsewhere in the state.

In-channel Islands

The addition of in-channel islands to the study area resulted in many more occurrences of sensitive plant species. The in-channel islands are generally without levees or riprap, and much of their area consists of tidally influenced marsh. This provides better habitat for species like Mason’s lilaeopsis, Delta mudwort, and rose-mallow that prefer tidal marsh to levee riprap. Mason’s lilaeopsis was found in 108 separate instances on in-channel islands, including 15 instances where the population was more or less continuous along the shoreline for some distance and was recorded as a line. There were only 12 occurrences of this species found on the islands proper, all small and isolated patches.

Delta mudwort was found 28 times on in-channel islands and only twice on the main islands. Rose-mallow was also much more common on the tidal islands, with 95 occurrences, including 7 that were mapped as more or less continuous populations, as compared with 18 occurrences, most consisting of single plants, found on the main islands.

Island Interiors

As in the previous study, no sensitive plant taxa were found within the levees of any island. Disturbance from farming activities and ditch maintenance has eliminated most native plant species from the island interiors, with the exceptions of some remaining patches of riparian vegetation and marsh around blowout ponds and other features. There is a CNDDB record of an occurrence of bristly sedge (*Carex comosa*) from one of the ponds on Webb Tract; we surveyed the area but were unable to determine whether this occurrence is still extant.

Sandy soils, potential habitat for Antioch Dunes evening primrose, Contra Costa wallflower, and Hoover's cryptantha, occur on Holland Tract and Webb Tract; however surveys of those sites found little native vegetation due to heavy disturbance from agriculture and grazing.

Levee modification evaluation

Additional riprap will not be added to two areas on Webb Tract and one area of Bacon Island (Figures 4-4 and 4-6). Riprap will be added to all other sections of levee on the reservoirs islands. Delta tule pea, Mason's lilaeopsis, rose-mallow, fox sedge, and Suisun aster currently exist on the levees and could be impacted by the additional rock placement.

Conclusions

The current study located 111 occurrences of special status plant taxa on the exterior levees of the project islands, 34 more than were found in the previous study. There were 39 occurrences on Bacon Island and 11 on Webb Tract, the two proposed reservoir islands. Seven occurrences were on Holland Tract, and 39 on Bouldin Island, the two proposed habitat islands. No occurrences were found in the interior of any island. There were 67 occurrences found on in-channel islands adjacent to Bacon Island; 49 adjacent to Webb Tract; 155 adjacent to Holland Tract; and 38 adjacent to Bouldin Island.

Potential impacts to special status plants on in-channel islands have not yet been identified. Special status plants occurring on the exterior levees of the reservoir islands will likely be impacted by levee reinforcement work and addition of riprap. On the habitat islands, levee maintenance requirements may result in some impacts to special status plant populations. Construction and maintenance of recreational and project facilities could potentially cause impacts to special status plants on the islands. These impacts will require implementation of mitigation measures. Mitigation measures could consist of:

∉ Conducting surveys for special status plant species prior to constructing any facilities.

∉ Site facilities to avoid impacts to special status plant species.

∉ Protecting special status plant species from construction activities and from recreational impacts.

A plan will be developed in consultation with DFG and USFWS to mitigate for unavoidable impacts to special status plant populations. This plan could include such measures as:

∉ Protecting and enhancing special status plant habitat on adjacent in-channel islands.

∉ Creating new habitat for special status species on in-channel islands or on the shores of the main islands.

∉ Transplanting individuals or colonies, or collecting and planting seed of special status plants into appropriate habitat on protected sites.

Chapter 5.0 Wildlife Resources

Introduction

DWR and Reclamation identified the need to update listed and special-status species information in the 2002 In- Delta Storage Program Planning Study Report on Environmental Evaluations. Species surveys and habitat assessments were conducted in 1988-1989 as part of the Delta Wetlands Project. Since that time, habitat conditions have changed on the project islands and additional listed species, such as the giant garter snake, have been observed on project islands. Additional wildlife surveys and habitat assessments for listed and special-status species were initiated to determine the potential impacts and mitigation required to comply with the federal Endangered Species Act, California Endangered Species Act, National Environmental Policy Act, California Environmental Quality Act, and Migratory Bird Treaty Act, should DWR and Reclamation decide to acquire the Delta Wetlands islands for the In-Delta Storage Project.

This chapter provides the updated species and habitat information for listed and special-status wildlife species and mitigation strategies. The information was collected during 2002 and 2003. Updated information is provided for the following species:

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus)* -FT
Giant garter snake (*Thamnophis gigas*) - FT/ST
Western pond turtle (*Emys marmorata*) - FSC/CSC
Greater sandhill crane (*Grus canadensis tabidia)* - ST
Swainson's hawk (*Buteo swainsoni*) - ST
California black rail (*Laterallus jamaicensis coturniculus)* - ST
Western burrowing owl (*Athene cunicularia hypugaea*) - FSC/CSC
Tricolored blackbird (*Agelaius tricolor*) - FSC/CSC
Loggerhead shrike (*Lanius ludovicianus*) FSC/CSC
Townsend's big-eared bat (*Corynorhinus townsendii*) FSC/CSC
Pallid bat (*Antrozous pallidus*) - CSC
Small-footed myotis (*Myotis ciliolabrum)* - FSC
Yuma myotis (*Myotis yumanensis)* - FSC
Red bat (*Lasiurus blossevillii*) WBWG - High

FT= Federal Threatened, ST=State Threatened, FSC=Federal Species of Concern, CSC=CA Species of Special Concern, WBWG-High=Western Bat Working Group High Priority

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (VELB), *Desmocerus californicus dimorphus*, has only been found in association with elderberry shrubs. All elderberry shrubs with one or more stems measuring 1.0 inch or greater in diameter at ground level and occur on or adjacent to a proposed project site must be thoroughly searched for beetle exit holes (USFWS 1999a). VELB exit holes are circular or slightly oval and are usually 7-10 millimeters (mm) in diameter (Barr 1991). The VELB is the only known insect to inhabit live elderberry wood or make exit holes of similar size and shape in the Central Valley (Nagano in Barr 1991).

Potential habitat for the VELB on In-Delta Storage Project islands is limited to one large cluster of elderberry shrubs located on the eastern levee of Holland Tract along Old River. The elderberry cluster contains several stems that are 1.0 inch or greater in diameter at ground level. The elderberry shrubs were thoroughly searched for the presence of VELB exit holes during the summer and in the winter. Neither VELB exit holes nor adult beetles were detected in the shrubs during the 2002-2003 field surveys. The elderberry shrubs lack overstory and understory vegetation and are located adjacent to the levee road. The cluster is also isolated from other elderberry shrubs. Therefore, VELB probably do not occur on Holland Tract. No other elderberry shrubs were found on project islands. JSA (1995a) reports that the nearest known VELB population is located along Middle River approximately 17 miles south of Bacon Island.

Giant Garter Snake Habitat Evaluations

A giant garter snake was found on Webb Tract in April 2001. USFWS reported sightings on Medford Island in 1996 and on Horseshoe bend in 1998. These sightings raised the question of whether giant garter snakes could be found on the project islands. For the purposes of the feasibility study, we assumed that giant garter snakes were present and completed a habitat evaluation to determine how much habitat existed on the project islands so we could estimate mitigation needs.

Habitat assessments for the giant garter snake were conducted in 2002 and reflect the site conditions at the time of the assessment. DWR acknowledges that the project islands are managed for agriculture and that habitat values and quantities for the giant garter snake are dynamic. Habitat conditions can change from year-to-year depending on the maintenance activities and the specific farming practices that are undertaken. DWR will conduct a survey to determine if giant garter snakes are present or absent on the reservoir islands in 2003 and in 2004. After the results of the 2003 surveys are completed, DWR will evaluate the results and determine, with the input from resource agencies, the objectives for the 2004 surveys. The habitat evaluations of the project islands presented in this section will be used to guide the presence/absence surveys and to determine the potential impacts and mitigation requirements assuming for planning purposes that giant garter snakes are present on the project islands.

Methods

Qualification of Habitat

Between August 31 and September 23, 2002, the four project islands (Bacon Island, Bouldin Island, Holland Tract, and Webb Tract) were visited by a DWR biologist and Eric Hansen, Consulting Herpetologist, for the purpose of evaluating the quality of potential giant garter snake (*Thamnophis gigas*) habitat present. Only the area owned by Delta Wetlands was evaluated, so most of the southwestern corner of Holland Tract was excluded from this task. Most of the primary access roads and some of the secondary roads were driven to get adequate coverage of the islands. Because complete coverage of the islands was not practicable, aerial photographs were used to determine the best areas to visit to take pictures of representative habitats. The locations of the pictures were recorded using a hand-held GPS unit, and habitat features were described into a micro cassette recorder. An evaluation method developed by Mr. Hansen was utilized, in which factors that determine the habitat's suitability for giant garter snake use are scored and zones of contiguous habitat are then categorized (Figure 5-1) (Hansen 2002). These factors are based on well-accepted and documented life history requirements of giant garter snakes. A thorough discussion of giant garter snake life history and ecology can be found in the U.S. Fish and Wildlife Service Draft Recovery Plan for the Giant Garter Snake (USFWS 1999b), Natural History of the Giant Garter Snake (Brode 1988), and Review of the Status of the Giant Garter Snake (Hansen 1988).

With georectified digital aerial photographs taken on April 23, 2001 as a template, all areas that appeared to hold water during at least some part of the year, as well as uncultivated upland areas, were digitized using ArcGIS 8.2. Irrigation ditches dominated the aquatic habitat on the islands, while blow-out ponds, borrow pits and exterior levee habitat, evaluated by Mr. Hansen during winter and spring 2002 (Hansen 2002), also contributed to the total amount of habitat evaluated and quantified. An evaluation was completed for each habitat feature (e.g., irrigation ditch, blow-out pond). When the value of a factor changed, a new evaluation was conducted, so most habitat features are characterized by multiple evaluations. This happened most often when a section of the irrigation ditch came within 200 feet of uncultivated upland. This triggered the inclusion of additional factors for scoring and frequently resulted in a different habitat quality value for that section of ditch (see evaluation method below). The 200-foot buffer is based on the definitions of "Giant Garter Snake Habitat" and "Disturbance Area" in the Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter and Yolo Counties, California (USFWS 1997b). For the purposes of that programmatic opinion, the U.S. Fish and Wildlife Service incorporated 200 feet of upland on each bank side of the linear aquatic habitat in its description of a giant garter snake habitat unit and its assessment of disturbance area. A complete description of the scoring technique utilized for these evaluations follows:

1. *Still or slow-flowing water over silt substrate* – This factor received a +1 if bank habitat adjacent to water was composed of soil, silt, or mud, and/or water flows no greater than 3 mph. Water will often look dark and murky like that seen in marshes, sloughs, or irrigation canals. A silt substrate also provides a muddy bottom into which giant garter snakes can bury themselves to escape predation. This factor received a 0 if no water was present at the time of the evaluation or if it the water and substrate were better characterized by Factor 2.
2. *Flowing water over sand, gravel, rock or cement substrate* – This factor received a -1 if bank habitat adjacent to water was composed of any of these substrates, and/or the water was flowing greater than 3 mph. Under these conditions, water will often appear clear, and a muddy bottom will not exist. Giant garter snakes, therefore, lack the protection provided by slow-moving water over a silt substrate, and the Recovery Plan states that "Giant garter snakes are absent from large rivers and from wetlands with sand, gravel, or rock substrates" (USFWS 1999b). This factor received a 0 if no water was present at the time of the evaluation or if the water flow and substrate were better characterized by Factor 1.
3. *Water available* – These categories are additive because the more persistent water is, the more consistent it's availability is for use by giant garter snakes.
   a) *Winter run-off only or sporadic availability* – This factor received a +1 for all aquatic habitat on the islands because they all received at least winter run-off, and water was only sporadically available for most habitat due to the crop types farmed.

b) *April through October only (irrigation)* – This factor received a +1 if water was available more than sporadically during the active season. At least some persistent water or sign of persistent water (e.g., green emergent marsh vegetation, moist soil) must have been present at the time of the evaluation for this factor to receive a positive score. This factor received a 0 if no water was present at the time of the evaluation and there did not appear to be a consistent water supply throughout the active season.

c) *All year* – This factor received a +1 if water appeared to be available during the entire year (e.g., blow-out ponds, main irrigation canals). This factor received a 0 if water did not appear to persist throughout the entire year.

4. *Banks are sunny* – This factor was given a score between +1 and +3 depending on the amount of direct sunlight the bank habitat adjacent to the water received. This score was influenced most strongly by the type of bank vegetation present and reflected the percent area available for basking. For example, banks dominated by Bermuda grass (*Cynodon dactylon*) and/or Himalayan blackberry (*Rubus discolor*) facilitate basking by providing exposed, stable platforms. Banks dominated by Johnson grass (*Sorghum halepense*) and/or barnyard grass (*Echinochloa crus-galli*) do not. This factor was given a score of 0 if no direct sunlight hit the habitat feature.
5. *Banks are shaded by overstory vegetation* – This factor was given a score between -3 and -1 depending on the amount of bank habitat adjacent to the water which received shade. Similar to Factor 4, this score was influenced strongly by the type of bank vegetation present and its ability to produce shade and preclude basking. Woody, overstory vegetation such as mature willows (*Salix* spp.) and cottonwoods (*Populus* spp.) impede a snake's ability to bask. Unlike mature willows, immature willows provide low branches facilitating aquatic escape and do not obscure sun. This factor was given a score of 0 if the banks received no shade.
6. 6. *Aquatic or emergent vegetation present* – This factor was given a score between +1 and +3 depending on the percent cover of emergent or aquatic vegetation (e.g., cattail (*Typha* spp.), bulrush (*Scirpus* spp.), water primrose (*Ludwigia peploides)*, water hyacinth (*Eichhornia crassipes*)) present within the bed of ditch and on the margins of the bank. Emergent aquatic vegetation can provide basking habitat, foraging opportunities, and cover from predators. This factor was given a score of 0 if aquatic or emergent vegetation was absent from the bed and banks.
7. Terrestrial vegetation present

   a) *On banks* – This factor was given a score between +1 and +3 depending on the percent cover of bank vegetation. The greater the amount of terrestrial vegetation present, the more cover from predators giant garter snakes gain. This factor received a score of 0 if there was no vegetation on the banks.

b) *On adjacent uplands* – This factor was given a score between +1 and +3 depending on the percent cover of uncultivated upland vegetation within 200 feet of the water. This factor was given a 0 if there were no uncultivated uplands within 200 feet of the water or if the uplands within this area possessed no vegetation.

8. Subterranean retreats present

   a) *In banks* – This factor received a score of +1 if bank habitat possessed burrows, holes, or cracks either in the soil or under debris. These burrows, holes, and cracks provide subterranean retreats for summer aestivation, overwintering, and cover from predators. This factor received a score of 0 if bank habitat lacked these features.

   b) *In adjacent uplands* – This factor received a score of +1 if uplands within 200 feet of the water possessed burrows, holes, or cracks either in the soil or under debris. This factor received a score of 0 if the uplands within 200 feet of the water lacked these features.

9. *Prey fish present* – This factor received a score of +1 if small aquatic prey fish (e.g., mosquitofish, blackfish) were observed or could be assumed present within the aquatic habitat. Prey fish were assumed to be present wherever it appeared water persisted beyond only sporadic availability. This factor received a score of 0 if small aquatic prey fish were absent or could be assumed absent, which was directly linked with presence of water.

10. *Introduced gamefish present* – This factor received a score of -1 if introduced gamefish (e.g., bass, catfish) were observed or could be assumed present within the aquatic habitat. Predatory gamefish such as these are often cited as a factor contributing to the apparent lack of giant garter snakes in large bodies of water (Brode 1988). Introduced gamefish were assumed to be present wherever it appeared that water persisted throughout the entire year and emergent aquatic vegetation was sparse (e.g., blow-out ponds, some main canals). This factor received a score of 0 if introduced gamefish were absent or could be assumed absent due to water persistence.

11. *Prey amphibians present* – This factor received a score of +1 if amphibians (e.g., bullfrog, treefrog) were observed or could be assumed present within or near the aquatic habitat. Giant garter snakes prey on both larval and adult frogs. When not directly observed, frogs were assumed to be present whenever the habitat feature was not completely dry at the time of the survey. This factor received a score of 0 if amphibians were absent or could be assumed absent due to lack of any water or moisture.

12. *Site is subject to severe seasonal or tidal flooding* – This factor received a score of -1 if the habitat feature was scheduled to be flooded over its banks during winter 2002-03. Flood waters can displace and even kill overwintering snakes. This factor received a 0 if the habitat feature was not scheduled to be flooded this winter or if it would not overtop its banks. The latter was assumed when a ditch was adjacent to a field scheduled for flooding and it was adjacent to a levee or access road with subterranean retreats, which would not be flooded.
13. *Adjacent land use*

    a) *Rice* – In terms of agricultural land, ricefields best resemble historic marsh habitat and can provide suitable foraging and basking habitat as well as shelter for giant garter snakes. None of the islands was farmed with rice, so this factor always received a score of 0 for these evaluations.

    b) *Upland* – This factor received a score of +1 if uncultivated uplands occurred within 200 feet of the habitat feature. Typically, these uplands provide basking habitat, possess subterranean retreats, and undergo less disturbance than other types of adjacent land use. Pasture land on Holland Tract was scored as uncultivated upland. This factor received a score of 0 if no uncultivated uplands occurred within 200 feet of the habitat feature.

    c) *Row Crop* – This factor received a score of -1 if row crops were grown within 200 feet of the habitat feature. In general, row crops are the product of intensive agricultural practices which disturb the land to the point that it does not provide any suitable habitat for giant garter snakes, and the farming practices themselves may injure or kill snakes. All of the islands, with the exception of Holland Tract, were intensively farmed in row crops. This factor received a score of 0 if row crops were not grown within 200 feet of the habitat feature.

    d) *Urban* – Run-off from urban areas can introduce pollutants into aquatic habitat, and the introduction and subsidization of predators such as cats and raccoons often accompanies human encroachment (Hansen 1988). None of the islands have urban development, so this factor always received a score of 0.
14. *Disturbance due to human recreational or maintenance activities* – This factor received a score of -1 if the habitat was subjected to prolonged or regular intense disturbance by human recreational or maintenance activities. Well-maintained and often-traveled access roads were included if they were directly adjacent to the habitat being evaluated because frequent traffic increases the risk of road mortality and regular disturbance can induce snakes to leave an area. This factor received a score of 0 if prolonged or regular disturbance by human recreational or maintenance activities did not occur. Activities such as periodic farm

maintenance constitute only a temporary and recoverable disturbance and were therefore scored as a 0.

15. *Connectivity to known populations of GGS* – Because the distribution of giant garter snakes in the Delta is largely unknown, this factor was not scored in these evaluations. All the Delta Wetlands Islands are hydrologically connected to historical and/or current giant garter snake occurrences and therefore could potentially support this species.

Total scores could have ranged between -8 and +22, but the actual range of values for the habitat features evaluated on the project islands was +3 to +19. Based on field observations in September 2002, the aerial photographs from April 2001, an understanding of the life history of giant garter snakes, and comparison of the total scores for each habitat feature, three levels of habitat quality were classified: low, moderate, and high. Generally, quality is determined by the habitat's ability to meet giant garter snake life history requirements. Specifically, quality is based on the presence and relative proportion of habitat factors necessary to support giant garter snakes and the amount of time that these factors are available during the April through October active season of the snake.

In general, high quality habitat possesses 1) sufficient water during the active summer season to supply cover and food such as small fish and amphibians; 2) emergent, herbaceous aquatic vegetation accompanied by vegetated banks to provide basking and foraging habitat; 3) bankside burrows, holes and crevices to provide short-term aestivation sites; 4) high ground or upland habitat above the annual high water mark to provide cover and refugia from floodwaters during the dormant winter season. Typically, habitat quality was classified as high when possessing all of these features for the entire active season, thereby providing stable habitat capable of supporting permanent populations of giant garter snakes. In general, moderate quality habitat possesses appropriate factors either temporarily or in marginal proportions, thereby providing giant garter snakes with only marginal or transient habitat less capable of sustaining permanent populations of snakes. In general, low quality habitat is incapable of supporting either permanent or temporary populations of giant garter snakes but is capable of providing transit corridors between more suitable habitats.

The divisions between the three habitat quality classifications were formed by comparing overall scoring results of the completed evaluations with known giant garter snake life history requirements. The point values for low quality habitat range between 3 and 7. The point values for moderate quality habitat range between 8 and 11. The point values for high quality habitat range between 12 and 19. The three levels of quality are represented by unique colors on the maps: blue = low, yellow = moderate, and red = high. Uncultivated, non-pasture uplands are mapped in green, but uplands were not evaluated for their quality.

Quantification of Habitat

From descriptions of ditch width transcribed from the micro cassette recordings and using a measurement tool in ArcGIS to take various measurements of ditch widths from the digital aerial photographs, the linear aquatic habitat on the interior of the island was divided into four general categories of width: 4, 12, 20, and 32 meters. Because ArcGIS was used to project the evaluations onto a digital aerial photograph, the length of each unique evaluation could be easily calculated. After assigning a width to each evaluation, area was calculated by multiplying length and width. The exceptions to this method of calculating area occurred when quantifying the levee habitat between the water channel and the toe ditch. Mr. Hansen's evaluations of the channel-side habitat were projected onto the digital aerial photographs, and the area for these linear segments was calculated from the edge of the aquatic vegetation, when present, to the crown of the levee. Likewise, the area of the levee toe ditch habitat was calculated from the edge of the ditch to the crown of the levee.

For non-linear aquatic habitat (e.g., blow-out ponds, borrow pits), the area that appeared to pond water, based on the aerial photographs from April 2001, was digitized, and a 200 foot buffer was created around it. As mentioned above, the 200-foot buffer was implemented based on definitions of giant garter snake habitat and disturbance area found within the U.S. Fish and Wildlife Service's Programmatic Consultation (USFWS 1997b). Therefore, the total area of non-linear aquatic habitat calculated for each island includes that 200-foot buffer of uplands, when it existed.

The boundaries of uncultivated uplands that were not already included in the linear and non-linear aquatic habitat quantifications were digitized using aerial photographs and descriptions of conditions observed in the field. Holland Tract is currently used as rangeland, and therefore the entire island could be considered upland. However, livestock grazing often results in the loss of bank and upland vegetation, as well as loss of upland refugia due to ground compaction. For this reason, only areas where livestock were excluded are included in the quantification of upland habitat because these are areas where subterranean retreats and dense vegetative cover potentially exist. These areas are either fenced or possess vegetation that is too dense to permit livestock access. Uplands included in the quantification of potential habitat were either located within 200 feet of aquatic habitat or were contiguous with uplands that were located within 200 feet of aquatic habitat.

Results And Discussion

Bacon Island

Bacon Island had a total of 734 acres (297 ha) of potential giant garter snake habitat in 2002 (Figure 5-2). Most of the linear aquatic habitat consisted of narrow trench ditches between fields of corn, sunflower, and harvested potato. These low quality ditches are likely only useful as transit corridors or provide only temporary habitat. One large north-south running canal bisects the island, and a few wider ditches running roughly east-west have perennial water. These ditches provided the only high quality habitat on the island, possessing the habitat features required to sustain a population of giant garter snakes. The toe ditches scored as moderate quality based on their proximity to uplands suitable for aestivation and overwintering. A large proportion of the area of moderate quality habitat can be attributed to these toe ditches. Sections of the exterior levee were heavily rip-rapped and offered very little suitable habitat, while others were characterized by freshwater emergent marsh and possessed better potential to support the species. Bacon Island had only one small borrow pit that appeared to hold winter run-off water during the spring, which would provide good, but temporary, habitat. Uplands included a large fallow field and a riparian area on the interior. Bacon Island is surrounded by many high quality in-channel islands, as well as the Western Pacific railroad tracks, and is located only 2.5 km (1.55 miles) away from a California Natural Diversity Database record of a giant garter snake skin found in 1996 on the southwest end of Medford Island (CNDDB 2002). While these additional factors did not contribute to the classification of habitat quality because adjacent habitat and connectivity to known populations of giant garter snakes were not scored in these evaluations, they warrant mention because they indirectly improve Bacon Island's potential to support giant garter snakes.

Table 5-1. 2002 Bacon Island Potential Giant Garter Snake Habitat

		Acres	Hectares
Linear Aquatic Habitat			
	High Quality	85	34
	Moderate Quality	461	186
	Low Quality	132	54
Non-linear Aquatic Habitat			
	High Quality	0	0
	Moderate Quality	3	1
	Low Quality	0	0
Uplands		53	22
TOTAL		734	297

Bouldin Island

Bouldin Island had a total of 957 acres (388 ha) of potential giant garter snake habitat in 2002 (Figure 5-3). Most of the linear aquatic habitat consisted of narrow trench ditches between fields of corn and grain providing only transit corridors and/or temporary habitat. A larger canal meandered through part of the island, and a few wider canals held water throughout the year. These provided the best overall quality habitat on the island due to consistent water availability and possession of decent aquatic and terrestrial vegetation, subterranean retreats, and prey. Like Bacon, Bouldin Island's toe ditches were typically moderate in quality and contributed greatly to the overall area of this level of habitat quality. The exterior levee habitat was also similar to Bacon's. On the interior, Bouldin Island had a number of areas that appeared to be old borrow pits that have since developed into marsh and riparian areas with water available at least part of the year. In some cases water persisted throughout the active season. Many of these areas contributed to the area of high quality. Uplands consisted of two small areas that appear to stay fallow and may provide suitable basking and/or aestivation sites due to their proximity to aquatic habitat. Bouldin Island is surrounded by a few in-channel islands of moderate and high quality, but not to the extent Bacon is. Bouldin Island is located approximately 5.7 km (3.54 miles) from Caldoni Marsh (CNDDB 2002), one of the thirteen populations of giant garter snakes recognized in the Recovery Plan (USFWS 1999b).

Table 5-2. 2002 Bouldin Island Potential Giant Garter Snake Habitat

		Acres	Hectares
Linear Aquatic Habitat			
	High Quality	117	47
	Moderate Quality	669	271
	Low Quality	132	53
Non-linear Aquatic Habitat			
	High Quality	26	11
	Moderate Quality	9	4
	Low Quality	0	0
Uplands		4	2
TOTAL		957	388

Holland Tract

Holland Tract had a total of 581 acres (235 ha) of potential giant garter snake habitat in 2002 (Figure 5-4). Because Holland Tract was used as rangeland, it had relatively few narrow trench ditches and consequently relatively less low quality habitat. In addition, because these narrow ditches were not directly adjacent to actively farmed land, they received higher overall scores than their counterparts on the other islands that were intensively farmed. However, they still likely only provided temporary and/or transit corridor habitat. Like Bacon, a main north-south running canal bisected the island, and a few wide east-west running canals apparently held water perennially. While there was evidence that livestock and their waste enter these ditches, overall they possessed those habitat features consistent with high quality (e.g., prey, aquatic and terrestrial vegetation, subterranean retreats, and naturally vegetated uplands). The exterior levee habitat on Holland Tract ranges from wide belts of freshwater emergent marsh to rip-rap and is classified as high, moderate, and low in certain sections. While the toe ditches don’t differ much from those on the other islands, they are not directly adjacent to intensive farming, and therefore possess slightly better quality. For this reason, some of the levee area associated with the toe ditches was classified as high as well as moderate. There is one large blow-out pond and a few borrow pits and low areas, which appear to pond water at least temporarily. While the large blow-out pond contains introduced predatory fish and has a sandy bottom which prevents snakes from burrowing in the mud to escape predators, it still possesses enough positive features to support giant garter snakes and qualify as high quality. The other areas could provide temporary habitat because they likely support populations of amphibian prey until they draw down. As mentioned above, the upland area calculated only includes those areas where livestock were excluded. The remainder of the uplands used by livestock totals approximately 3680 acres (1489 ha), but this area is less suitable for giant garter snake use because livestock grazing often results in the loss of bank and upland vegetation, as well as loss of upland refugia due to ground compaction. Holland Tract is surrounded by many high quality in-channel islands and is located nearly equidistant between two recent giant garter snake records: the abovementioned skin found on the southwest end Medford Island in 1996 and a snake found on the southwest end of Webb Tract in 2002 (5.9 km (3.67 miles) and 5.6 km (3.48 miles), respectively) (CNDDB 2002).

Table 5-3. 2002 Holland Tract Potential Giant Garter Snake Habitat

		Acres	Hectares
Linear Aquatic Habitat			
	High Quality	181	73
	Moderate Quality	286	116
	Low Quality	8	3
Non-linear Aquatic Habitat			
	High Quality	45	18
	Moderate Quality	37	15
	Low Quality	0	0
Uplands		24	10
TOTAL		581	235

Webb Tract

Webb Tract had a total of 949 acres (384 ha) of potential giant garter snake habitat in 2002 (Figure 5-5). While a fair amount of the linear aquatic habitat consisted of low quality, narrow trench ditches that likely provided only transit corridor and/or temporary habitat, Webb Tract had relatively more wide canals with persistent water than the other islands. The main north-south and east-west canals possessed all the factors necessary to support a permanent population of giant garter snakes (e.g., permanent water, aquatic and terrestrial vegetation, prey, subterranean retreats, as well as a wide upland shelf between the canal and agricultural activity). Like the other islands, the exterior levee habitat ranged from heavy rip-rap to emergent marsh, which qualified as low and moderate habitat. Parts of the toe ditch appeared to be wider with more persistent water than other parts. These more closely resembled the main north-south and east-west canals, although they were narrower, and were classified as high quality habitat. The remainder of the toe ditch was similar to those on other islands and probably only provided temporary or marginal habitat value. Webb Tract has two large blow-out ponds and a couple borrow pits or depressions that appear to pond water. While the blow-out ponds contain predatory fish and a sandy bottom to some extent, they also possess nice patches of emergent marsh, expansive uplands, and prey. All the borrow pits were dry in September, so they would only provide temporary habitat. Uplands on Webb Tract were primarily characterized by riparian vegetation surrounding the blow-out ponds; however, there were some patches of fallow land that could provide basking, aestivation, and overwintering habitat. Webb Tract is surrounded by some high and moderate quality in-channel islands, as well as some wide, fast-flowing channels. A giant garter snake was found on Webb Tract in April 2002 near the ferry dock, and the next closest CNDDB record is 5.2 km (3.23 miles) away between Highway 160 and Horseshoe Bend where a snake was observed in 1998 (CNDDB, 2002).

Table 5-4. 2002 Webb Tract Potential Giant Garter Snake Habitat

	Acres	Hectares
Linear Aquatic Habitat		
High Quality	168	68
Moderate Quality	452	183
Low Quality	97	39
Non-linear Aquatic Habitat		
High Quality	55	22
Moderate Quality	92	37
Low Quality	0	0
Uplands	85	34
TOTAL	949	384

Delta Wetlands Islands Total

The total amount of potential giant garter snake habitat for all four islands visited in 2002 is 3221 acres (1304 ha). Of that, approximately 677 acres (273 ha) is high quality habitat, 2009 acres (813 ha) is moderate quality habitat, 369 acres (149 ha) is low quality habitat, and 166 acres (68 ha) is upland. When looking at Figures 5-2 to 5-5, there appears to be a substantially higher proportion of low quality linear aquatic habitat (except on Holland Tract), but in reality the total area of low quality habitat is much smaller than that for high or moderate quality linear aquatic habitat (see tables above). Nearly all of the low quality ditches were narrow, so while length of low quality habitat greatly exceeded that of moderate or high quality, overall area did not. In addition, none of the toe ditch-to-levee crown nor ponds and borrow pits ranked any lower than moderate quality. To reiterate, areas classified as high quality habitat normally provide stable habitat capable of supporting permanent populations of giant garter snakes. Typically, areas classified as moderate quality habitat would provide giant garter snakes with only marginal or transient habitat less capable of sustaining permanent populations. And generally, areas classified as low quality are incapable of supporting either permanent or temporary populations of giant garter snakes but can provide transit corridors between more suitable habitats.

On February 5, 2003, Eric Hansen and staff from USFWS, DFG, DWR, Reclamation and CH2M HILL met to discuss the giant garter snake (GGS) habitat evaluations and appropriate mitigation for loss of potential habitat on the reservoir islands. At this meeting USFWS decided that all habitat that ranked as low quality was so poor that mitigation would not be required for its loss; however, all moderate and high quality habitat would require 3:1 mitigation. The USFWS also maintained that mitigation would not be required for suitable upland habitat that was greater than 200 feet from moderate or high quality aquatic habitat. Based on this direction from the USFWS, DWR staff recalculated the amount of potential GGS habitat that would be lost from the reservoir islands. The resulting areas of potential GGS habitat are 458 acres on Bacon Island and 657 acres on Webb Tract. Therefore, the total area requiring mitigation is 1,115 acres, which at 3:1 amounts to 3,345 acres of suitable GGS habitat that must be preserved or created on the habitat islands.

Figure 5-1. Habitat Evaluation And Scoring Form For Geographic Information Systems (GIS)

Giant Garter Snake (*Thamnophis gigas*)

Site Name:____________________________________Site ID:___________________

GeneralCharacteristic:____

USGS 7.5' Topo Quad__________________ Township_______ Range________

Surveyor/Affiliation: _________________________________ Date(s): ____________

Scores: 0=absent/none 1=present/low (0-25%) 2=moderate (25-75%) 3=high (75-100%)

Factor (* indicates presence/absence only)	State	Score
1. Still or slow-flowing water over silt substrate	**( ) ***	**( ) +**
2. Flowing water over sand, gravel, rock or cement substrate	**( ) ***	**( ) --**
3. Water available (categories are additive):		
a) Winter only (runoff) or sporadic availability	**( ) ***	**( ) +**
b) April through October only (irrigation)	**( ) ***	**( ) +**
c) All year	**( ) ***	**( ) +**
4. Banks are sunny	**( )**	**( ) +**
5. Banks shaded by overstory vegetation	**( )**	**( ) --**
6. Aquatic or emergent vegetation present	**( )**	**( ) +**
7. Terrestrial vegetation present		
a) On banks	**( )**	**( ) +**
b) On adjacent uplands	**( )**	**( ) +**
8. Subterranean retreats present		
a) In banks	**( ) ***	**( ) +**
b) In adjacent uplands	**( ) ***	**( ) +**
9. Prey fish present	**( ) ***	**( ) +**
10. Introduced gamefish present	**( ) ***	**( ) --**
11. Prey amphibians present	**( ) ***	**( ) +**
12. Site subject to severe seasonal or tidal flooding ( ) --	**( ) ***	
13. Adjacent land use		
a) Rice	**( ) ***	**( ) +**
b) Upland	**( ) ***	**( ) +**
c) Row Crop	**( ) ***	**( ) --**
d) Urban	**( ) ***	**( ) --**
14. Disturbance due to human recreational or maintenance activities	**( ) ***	**( ) --**
15. Connectivity to known populations of GGS	**( ) ***	**( ) +**

Total: ☐

For additional maps or notes use back of page

Modified from U.S. Fish and Wildlife Service. 1999. Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). Appendix D: Page 157. Modified for scoring by Eric. C Hansen: 2001

Figure 5-2. Potential Giant Garter Snake Habitat – Bacon Island, 2002

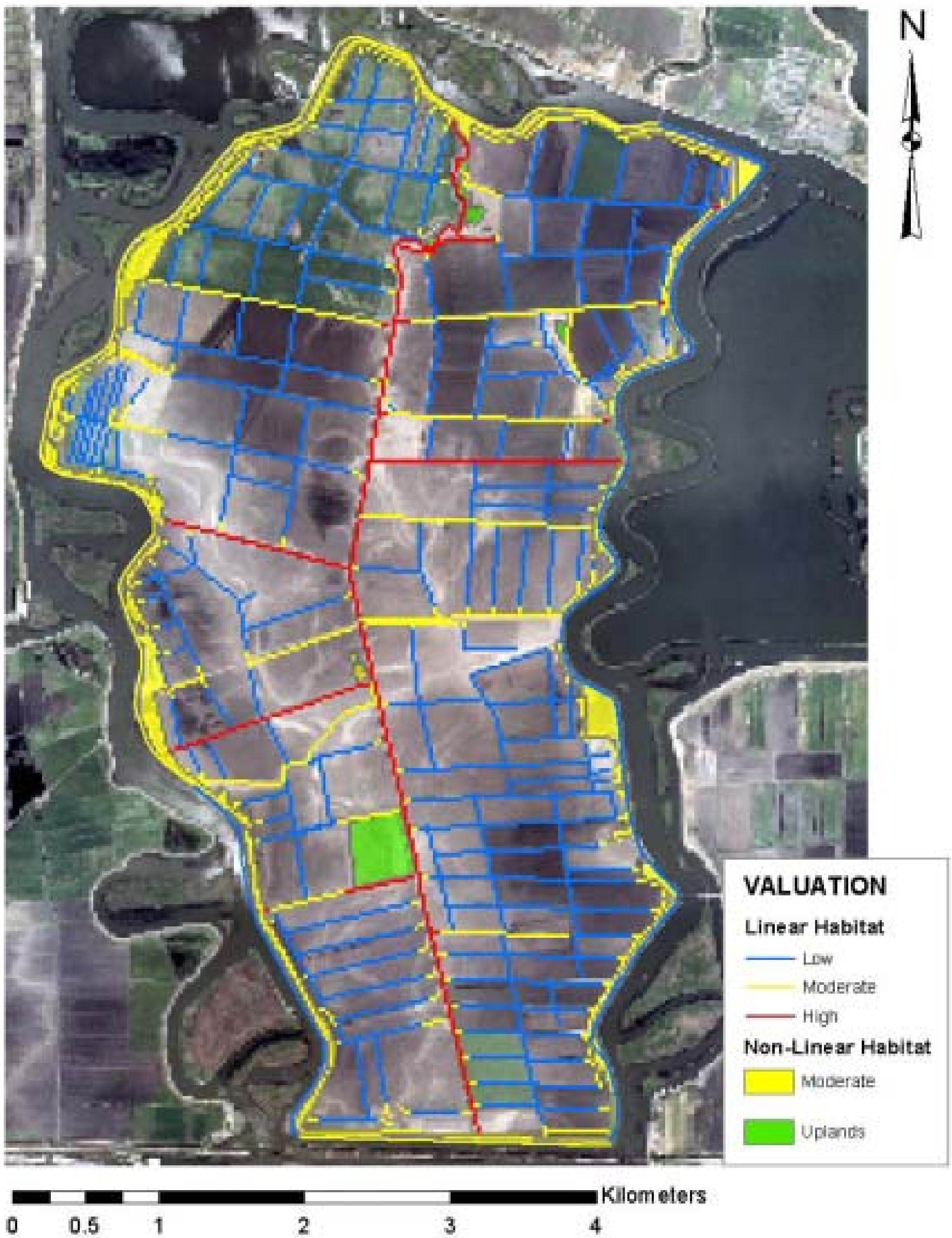


Figure 5-3. Potential Giant Garter Snake Habitat – Bouldin Island, 2002

Figure 5-4. Potential Giant Garter Snake Habitat – Holland Tract, 2002

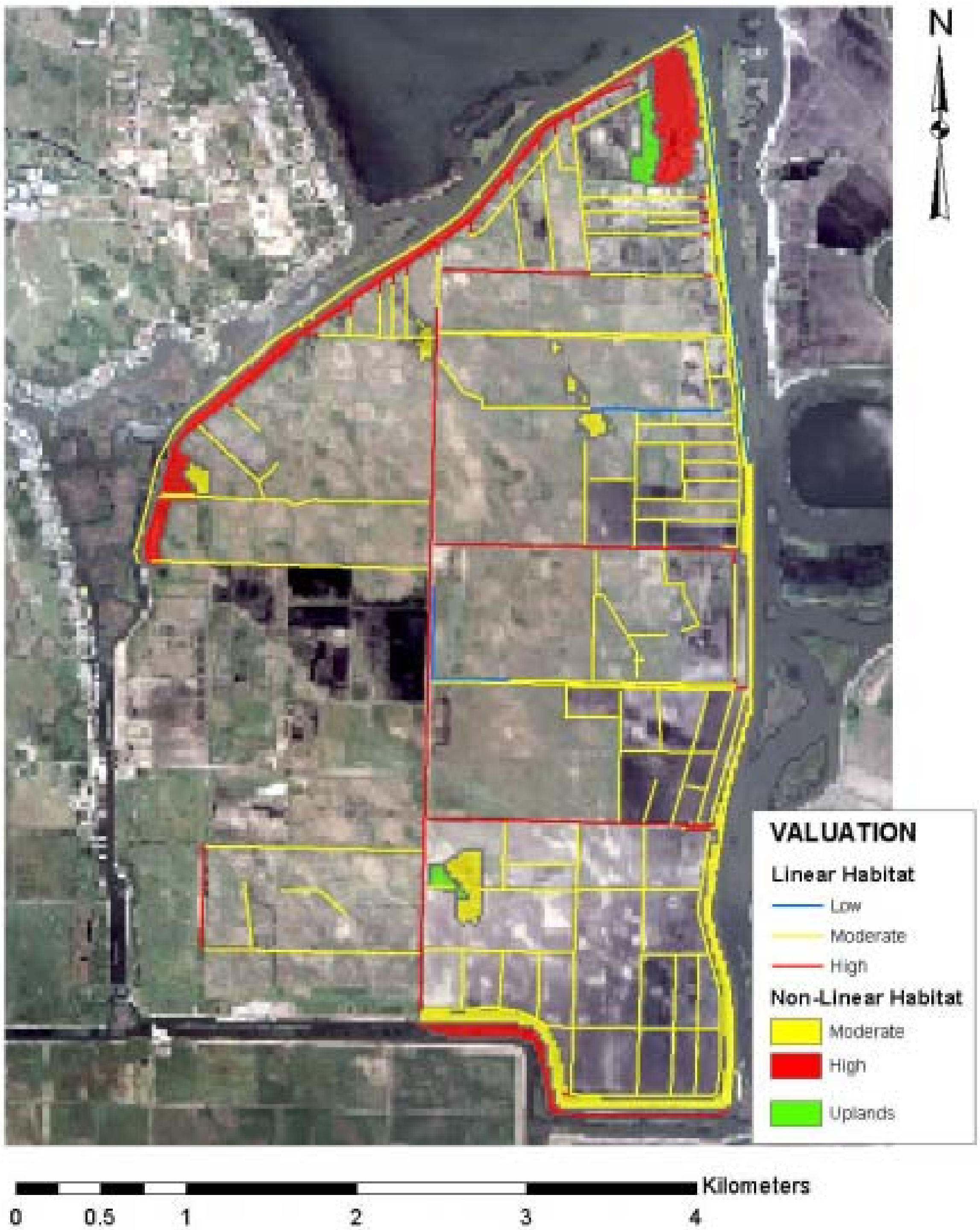


Figure 5-5. Potential Giant Garter Snake Habitat – Webb Tract, 2002

Western Pond Turtle

The western pond turtle (*Emys marmorata*) belongs to the box and water turtle family, Emydidae, and is the only native freshwater turtle west of the Sierra Nevada-Cascade divide (Storer 1930). Western pond turtles are small to medium sized turtles (straight-line carapace length 110-210 mm in adults) with a low to moderately domed shell that is olive, dark brown, gray, or black and lacks prominent markings. Western pond turtles are habitat generalists, historically occurring in a wide variety of fresh and brackish, permanent and intermittent aquatic habitats (Holland 1991). They can be found living in sloughs, streams (permanent and intermittent), large rivers, lakes, ponds, vernal pools, and even irrigation ditches, but they prefer aquatic habitat with still or slow-flowing water, adequate vegetative cover, and exposed basking sites (Holland 1991; Ernst and others 1994). Hatchlings and small juveniles require specialized microhabitats, characterized by shallow water (less than 30 cm deep), with emergent vegetation usually rushes (*Juncus* sp.) or sedges (*Carex* sp.) but often cattails (*Typha* sp.) or bulrushes (*Scirpus* sp.) (Holland 1991).

There is a paucity of information on western pond turtle nest site characteristics, and relatively little is understood about their reproductive ecology. Females typically oviposit from May through July (Holland 1991). Storer (1930) reported that along the courses of the large rivers, females typically deposited their eggs in the sandy banks, and Holland (1991) noted that females tended to place their nests on grassy, unshaded south-facing slopes. Holte (1998) described western pond turtle nest sites as typified by low slopes; southern aspects; dense low-growing forbes and grasses with no overstory cover; and dry, compact soil during nesting and overwintering periods with short periods of inundation during winter. Eggs usually hatch in late summer, and hatchlings often overwinter in the nest, emerging the following spring (Holland 1991).

While some western pond turtles spend the winter in aquatic habitats, most overwinter terrestrially. Holland (1991) claimed that overwintering is one of the least understood aspects of the natural history of the western pond turtle. Davis (1998) reported that along a central coast California stream, western pond turtles buried themselves in leaf litter or soil primarily in riparian forests with a dense native understory. Rathbun and others (2002) also found that most western pond turtles overwintering on land preferred dense riparian thickets dominated by willows (*Salix* sp.) with a thick understory of blackberry (*Rubus* sp.), poison oak (*Toxicodendron diversilobum*), and Cape ivy (*Delaria odorata*).

The western pond turtle is listed as a Federal Species of Concern by the U.S. Fish and Wildlife Service and a Species of Special Concern by the California Department of Fish and Game (DFG 2002). Major factors contributing to the decline of this species are most likely related to the adverse effects of conversion of aquatic, wetland, riparian, and adjacent upland habitats to other land uses such as agriculture, urban, and industrial, or as a result of ongoing land-use practices (CALFED 2000). The aquatic habitats that persist are largely fragmented, and associated upland habitats are typically unavailable; those remaining are often isolated in narrow bands along rivers, streams, and canals with small levees (CALFED 2000). While finding western pond turtles in the Sacramento-San Joaquin Delta is still relatively easy, it has been reported that most individuals seen are large, old turtles and that observations of hatchlings and small turtles are increasingly rare (CALFED 2000). If this is the case, factors that could contribute to poor reproductive success include elimination of suitable breeding sites, predation on hatchlings by non-native predators, predation on eggs, diseases introduced by non-native turtles, and shortage of safe upland overwintering refuges (CALFED 2000). Due to its declining status, CALFED (2000) recognized the western pond turtle as a species that warrants conservation efforts, and its vision for this species is to increase, or at least not adversely impact, the abundance and distribution of its populations.

Surveys for western pond turtles were not conducted during preparation of the Delta Wetlands (DW) Project EIR/EIS and associated biological assessments, and no turtles were recorded during surveys for other species at the time (JSA 1995a). It was noted in the DW Project EIR/EIS, however, that western pond turtles had been observed using the blow-out pond on Holland Tract in the past and that potential habitat existed on all four DW project islands (Bacon Island, Bouldin Island, Holland Tract, and Webb Tract) (JSA 1995a). Aquatic habitat on the project islands' interiors consists primarily of blow-out ponds and irrigation ditches, while suitable upland habitat exists for the most part only on the perimeter levees and surrounding the blow-out ponds. Patches of aquatic vegetation, most often *Scirpus* sp. and/or *Egeria densa*, border all of the project islands, and to a certain extent they are all surrounded by in-channel islands.

One component of the In-Delta Storage Project involves strengthening the reservoir island levees (Bacon Island and Webb Tract). Two options are being considered: 1) riprap the entire interior side of the levee but only where needed on the exterior side (riprap option), and 2) where necessary, modify the existing levee into a bench and create an interior levee, which would have riprap on both its exterior and interior sides (bench option) (See the In-Delta Storage Project Feasibility Study engineering reports for a detailed description of the bench option). The modifications to the existing levee would involve removing the top of the levee leaving three possible bench elevations depending on what is needed. At the lowest elevation, emergent marsh vegetation would establish on the bench. At the mid-elevation, willow and alder dominated riparian vegetation would establish on the bench. At the highest elevation, cottonwood dominated riparian vegetation would establish on the bench. The amount of western pond turtle habitat that will be destroyed or created as a result of levee strengthening depends on how much is necessary and which option is employed. Additionally, all habitats on the interior of the reservoir islands will be lost as a result of project operations, but the habitats created on the habitat islands (Bouldin Island and Holland Tract) are intended to mitigate those losses. DWR biologists conducted an evaluation to identify the potential impacts to western pond turtles from the levee modification options.

Methods

Distribution and Habitat Use

During spring and summer 2002, DWR wildlife biologists and botanists conducted surveys for sensitive species on the In-Delta Storage Project islands and surrounding in-channel islands. Due to scheduling difficulties with boat and surveyor availability, some of the in-channel islands were not surveyed and none of the In-Delta Storage Project islands' interiors were surveyed specifically for western pond turtles. Boat surveys for western pond turtles were conducted on July 25th, August 23rd and 30th. These surveys consisted of a boat operator and an observer traveling around the perimeter of the project islands and some in-channel islands at varying rates of speed depending on the habitat quality searching for basking western pond turtles. When western pond turtles were observed incidentally during surveys for other species, they were recorded on most occasions. All recorded sightings of western pond turtles were mapped using digital georectified aerial photographs, taken by DWR in April 2001, as a basemap in ArcGIS. In addition, a search of the California Natural Diversity Database (CNDDB) provided locations for past observations, which were also mapped using this method (DFG 2002).

Quantification of Habitat

Aquatic Habitat: Locations of aquatic vegetation bordering the reservoir islands' (Bacon Island and Webb Tract) exterior levees were identified and measured linearly using the digital georectified aerial photographs in ArcGIS. Based on measurements made in ArcGIS and field observations, an average width of 8 meters was assigned to these distances to develop an estimate of area. Since no modification of the habitat islands' (Bouldin Island and Holland Tract) levees has been proposed, no loss of habitat around those islands is expected and no calculations of exterior side aquatic habitat were made. Areas of aquatic habitat, in the form of blow-out ponds and large irrigation canals, on the interior of all four islands were quantified using ArcGIS; however, the southwest section of Holland Tract was not included because it is not included in the project area. While smaller irrigation canals with intermittent water supplies represent potential western pond turtle habitat; they were not included because they are only marginally valuable at best due to their limited temporal availability.

Upland Habitat: Nearly 100% of the exterior side of the levees has been riprapped with what little natural vegetation that exists located near the crown. In addition, this side of the levee has the potential for inundation during flood years, which could destroy and/or displace nests and overwintering turtles. Therefore, for the purposes of this analysis, none of the land on the exterior side of the levee was included in the quantification of suitable upland habitat. Nearly 100% of the interior side of the levee on all four islands possesses natural vegetation at some point during the year. However, routine maintenance of these slopes may preclude successful nesting and typically removes woody vegetation that would improve the habitat for overwintering turtles. For the purposes of this analysis, approximately all of the land from the crown of the levee to the toe drain on the interior that was characterized by southern aspects and/or riparian vegetation was included in the quantification of suitable uplands. Any additional naturally vegetated uplands that could potentially support nesting and/or overwintering western pond turtles were also included in this quantification.

Proposed Habitat: The Habitat Management Plan (HMP)(JSA 1995b) details the types and quantities of habitat that may be created on the habitat islands. Modifications to the HMP may be necessary to meet mitigation requirements for giant garter snakes, Swainson's hawks and greater sandhill cranes. The proposed modifications for the HMP were not available at the time of this evaluation, so the evaluation is based on the descriptions of the habitat types in the existing HMP (JSA 1995b). Staff assessed the relative quality of 1995 HMP habitats to western pond turtles. The 1995 HMP, current literature, and personal observations on western pond turtle life history were used as a foundation. Seasonal pond, emergent marsh, permanent lake, canal, borrow pond, herbaceous upland, and riparian habitats are suitable for use by western pond turtles, while corn rotated with wheat, small grain crops, mixed agriculture/seasonal wetland, seasonal managed wetland, and pasture/hay are not. Quantities of currently available aquatic and upland habitat on the exterior of the reservoir islands and to the interior of all four islands were compared to the availability of aquatic and upland habitat in the 1995 HMP to assess whether the habitat islands would adequately mitigate impacts to western pond turtles and their habitat.

Results

Webb Tract

The exterior of Webb Tract and all of the surrounding in-channel islands were surveyed by boat for western pond turtles in 2002. Six western pond turtles were recorded on the exterior levee of Webb Tract, and one was observed using an in-channel island adjacent to the island (Figure 5-6). All of the turtles were observed basking on logs or other debris situated within patches of emergent vegetation. Most of the western pond turtles were found along Fisherman's Cut where water flows are presumably slower than those of the surrounding rivers. Both of the observations outside of Fisherman's Cut were along the San Joaquin River and had in-channel islands directly adjacent to them. No western pond turtles were observed on the interior of Webb Tract, and none were reported to the CNDDB in the immediate vicinity (DFG 2002).

Approximately 25% of Webb Tract's 21 km (13 mile) perimeter levee, or approximately 4 ha (10 acres), is bordered by shallow water with aquatic vegetation. On the interior of Webb Tract, approximately 35.5 ha (88 acres) of canal and associated bankside constitute suitable western pond turtle habitat. In addition, the two large blow-out ponds and one small borrow pond total approximately 35 ha (87 acres) of aquatic habitat. There are approximately 140 ha (347 acres) of upland suitable for nesting and/or overwintering. All suitable habitat on the interior of the island will be lost when the project is operational. If the riprap option is implemented, up to 10 acres of exterior aquatic habitat could be lost at the toe of the existing levee. If the bench option at the lowest elevation is employed, there will be no loss of exterior aquatic habitat because we assume the aquatic habitat and the toe of the levee will be untouched. Nevertheless, the quality of this habitat will greatly diminish due to the loss of the adjacent uplands that will be riprapped under this option. In areas where either the mid-elevation or high-elevation benches are created, a net loss of suitable habitat will occur because neither of these habitats will be very useful to western pond turtles and, therefore, cannot be considered replacement habitat.

Bacon Island

Only the exterior of Bacon Island was surveyed by boat for western pond turtles. The in-channel islands surrounding most of Bacon Island were not formally surveyed for this species; however, there were past observations of many western pond turtles using these islands in the CNDDB (DFG 2002), and they continue to represent high quality habitat. Five western pond turtles were recorded in four locations on the exterior levee of Bacon Island in 2002, and one western pond turtle was observed basking on a large branch inside the main north-south canal on the interior of the island (Figure 5-7). One of the western pond turtles on the exterior levee was observed basking on a diversion pipe.

Approximately 75% of Bacon Island's 23 km (14 mile) perimeter levee, or approximately 14 ha (34 acres), is bordered by shallow water with aquatic vegetation. On the interior of Bacon Island, approximately 35 ha (86 acres) of canal and associated bankside, as well as approximately 28 ha (70 acres) of upland, constitute suitable western pond turtle habitat. All of this interior habitat will be lost as a result of this project. If the riprap option is implemented, up to 34 acres of exterior aquatic habitat at the toe of the existing levee could be removed. If the bench option at the lowest elevation is employed, there will be no loss of exterior aquatic habitat (assuming that the aquatic habitat at the toe of the levee will remain untouched); however, the quality of this habitat will greatly diminish due to the loss of the adjacent uplands that will be riprapped under this option.

Bouldin Island

The exterior of Bouldin Island and some of the surrounding in-channel islands were surveyed by boat for western pond turtles in 2002. Fourteen western pond turtles were recorded on the exterior levee of Bouldin Island, and three were observed using an in-channel island on the south side of the island (Figure 5-8). Most were observed basking on logs situated within patches of emergent vegetation. Two western pond turtles were observed across from Tower Park Marina; one was basking on a diversion pipe, and the other was submerged surrounded by a patch of *Egeria densa*. One western pond turtle was found dead on the levee road near Highway 12 on the western side of the island. While no western pond turtles were observed using the in-channel islands on the north side of Bouldin Island during the 2002 surveys, relatively large numbers were recorded there in 1994 (DFG 2002). In addition, a western pond turtle was observed in one of the irrigation ditches near Highway 12 in 2001 (DFG 2002).

The interior of Bouldin Island currently possesses approximately 59 ha (147 acres) of canal and associated bankside, as well as 62 ha (153 acres) of upland, that represent suitable western pond turtle habitat. In addition, there are three borrow ponds that appear to hold water most of the year, totaling approximately 10.5 ha (26 acres) of emergent marsh habitat. According to the HMP, 66 acres of seasonal pond, 208 acres of emergent marsh, 111 acres of permanent lake, 70 acres of canal, 89 acres of borrow pond, 479 acres of herbaceous upland, and 170 acres of riparian habitat will either be created or preserved on Bouldin Island (JSA 1995b).

Holland Tract

The exterior of Holland Tract and most of the surrounding in-channel islands were surveyed by boat for western pond turtles in 2002. Nine western pond turtles were recorded on the exterior levee of Holland Tract, and three were observed using the in-channel islands surrounding the island (Figure 5-9). Most were observed basking on logs or diversion pipes in Sand Mound Slough, where the water is shallow and flows slowly, boat traffic is light and slow, and emergent vegetation is abundant. Other than the western pond turtles that had been reported using in-channel islands located between Holland Tract and Bacon Island, the CNDDB only had one other record of a western pond turtle in the vicinity of Holland Tract (DFG 2002). It was observed basking on a log near the southwestern corner of Holland Tract (DFG 2002). Three turtles were recorded on the island’s interior; one was seen basking on a log in the blow-out pond on November 13th, and two were seen in one of the large east-west irrigation ditches.

The portion of Holland Tract that is included in this project currently possesses approximately 23 ha (58 acres) of canal and associated bankside, as well as 67.5 ha (167 acres) of upland, on its interior that constitute western pond turtle habitat. In addition, there is a large blow-out pond totaling approximately 5.5 ha (13 acres). According to the HMP, 68 acres of seasonal pond, 194 acres of emergent marsh, 33 acres of permanent lake, 10 acres of canal, 253 acres of herbaceous upland, and 217 acres of riparian will be either be created or preserved on Holland Tract (JSA 1995b).

Potential Impacts

Because the survey effort to date has been inadequate to ascertain precisely how valuable each of the DW islands are to western pond turtles, it is difficult to determine whether the mitigation strategies proposed in the Habitat Management Plan will sufficiently mitigate project impacts. Fortunately, based on the survey results it appears that, in general, more western pond turtles are using the proposed habitat islands than the proposed reservoir islands. This could be due in part to the fact that both islands have marinas on or adjacent to them where boat speeds are not supposed to exceed 5 mph. In addition, Holland Tract is bounded by Sand Mound Slough on the west, which is shallow and heavily vegetated with slow-flowing to still water and relatively slow boat speeds.

It appears that the habitat islands will sufficiently mitigate losses to western pond turtle aquatic habitat but possibly not upland habitat. Approximately, 261 acres of suitable aquatic habitat will be lost from the interior of the reservoir islands and as much as 44 acres on the exterior. However, 849 acres of seasonal ponds, emergent marsh, permanent lakes, canals, and borrow ponds will be created or preserved on the habitat islands. Of this 849 acres, approximately 244 acres already exists, which means 605 acres will be created as mitigation for the up to 305 acres lost. Approximately 417 acres of suitable upland (herbaceous upland and riparian) habitat will be lost from the interior of the reservoir islands, and approximately 320 acres of upland habitat currently exists on the habitat islands. The HMP proposes to create or preserve a total of 1,119 acres of herbaceous upland (732 acres) and riparian (387 acres) vegetation. Unfortunately, most of this herbaceous upland is located on the perimeter levees. This habitat already exists, so it should not be considered compensation for losses on the reservoir islands. In addition, not all of these upland habitats are suitable for nesting and/or overwintering, so the total amount created and/or preserved in the HMP is an overestimate of the amount of habitat that would actually benefit western pond turtles.

If the total amount of herbaceous upland cannot be increased, reconfiguration of the current acreages could improve the chances of western pond turtles successfully nesting on the habitat islands. Currently, there are three north-south patches of upland proposed on Bouldin Island. If these were rotated so that they ran east-west and were given a low to moderate slope, it would create a south-facing slope which has the potential to be used by nesting turtles. In addition, part of one of these “uplands” is slated to become a borrow pond, which would further decrease the amount of uplands available. An effort should be made to create herbaceous uplands with south-facing slopes around all permanent lakes, ponds, and emergent marsh habitats. These important aquatic habitats can be further enhanced by placing logs around the perimeter to create basking habitat.

In addition to the deficiency of suitable nesting habitat, some of the scheduled maintenance activities may preclude successful nesting by western pond turtles in areas where it actually exists. For example, exterior and interior levee maintenance is scheduled for late-spring through August, but this is the time when western pond turtles are nesting. As the habitat islands are currently designed, the vast majority of suitable nesting habitat is located on the perimeter levees and would be disturbed by these activities. Since hatchlings most likely overwinter in the nest, winter is not a good time for levee maintenance. If suitable uplands cannot be created around the lakes, ponds, and emergent marsh, then conducting maintenance of the levees after the hatchlings have emerged but before the females are attempting to nest (mid-April through mid-May) should be included in the management plan.

Recommendations

- The revised HMP proposes to develop 216 additional acres of herbaceous uplands than what is in the 1995 HMP. The herbaceous uplands should be designed to provide nesting and overwintering habitat for the western pond turtle.
- The revised HMP proposes to develop about 200 more acres of suitable emergent marsh than what is in the 1995 HMP. Emergent marsh habitat should be designed to provide suitable habitat for the western pond turtle.

Figure 5-6. Webb Tract Western Pond Turtle Occurrences and Habitat

Figure 5-7. Bacon Island Western Pond Turtle Occurrences and Habitat

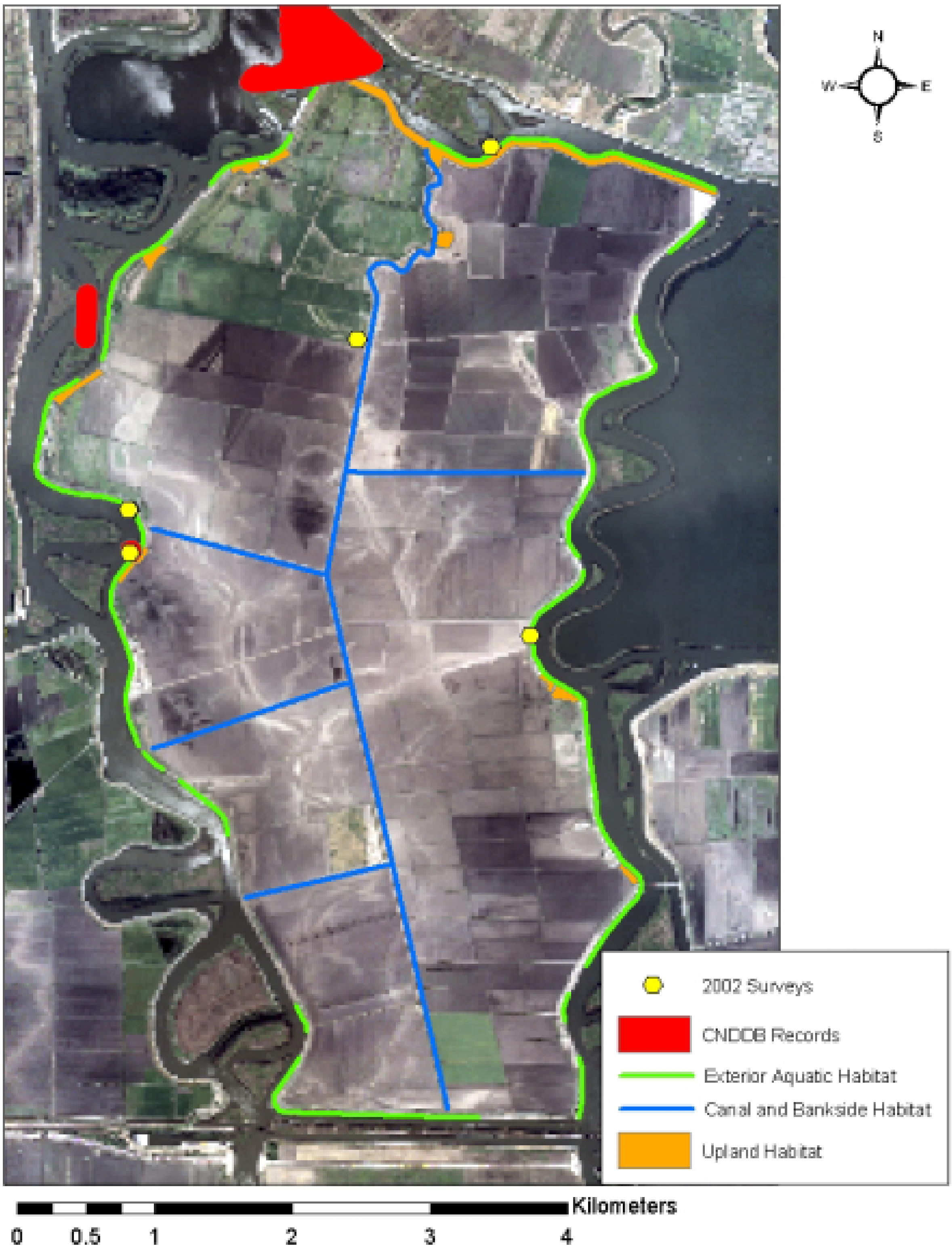


Figure 5-8. Bouldin Island Western Pond Turtle Occurrences and Habitat

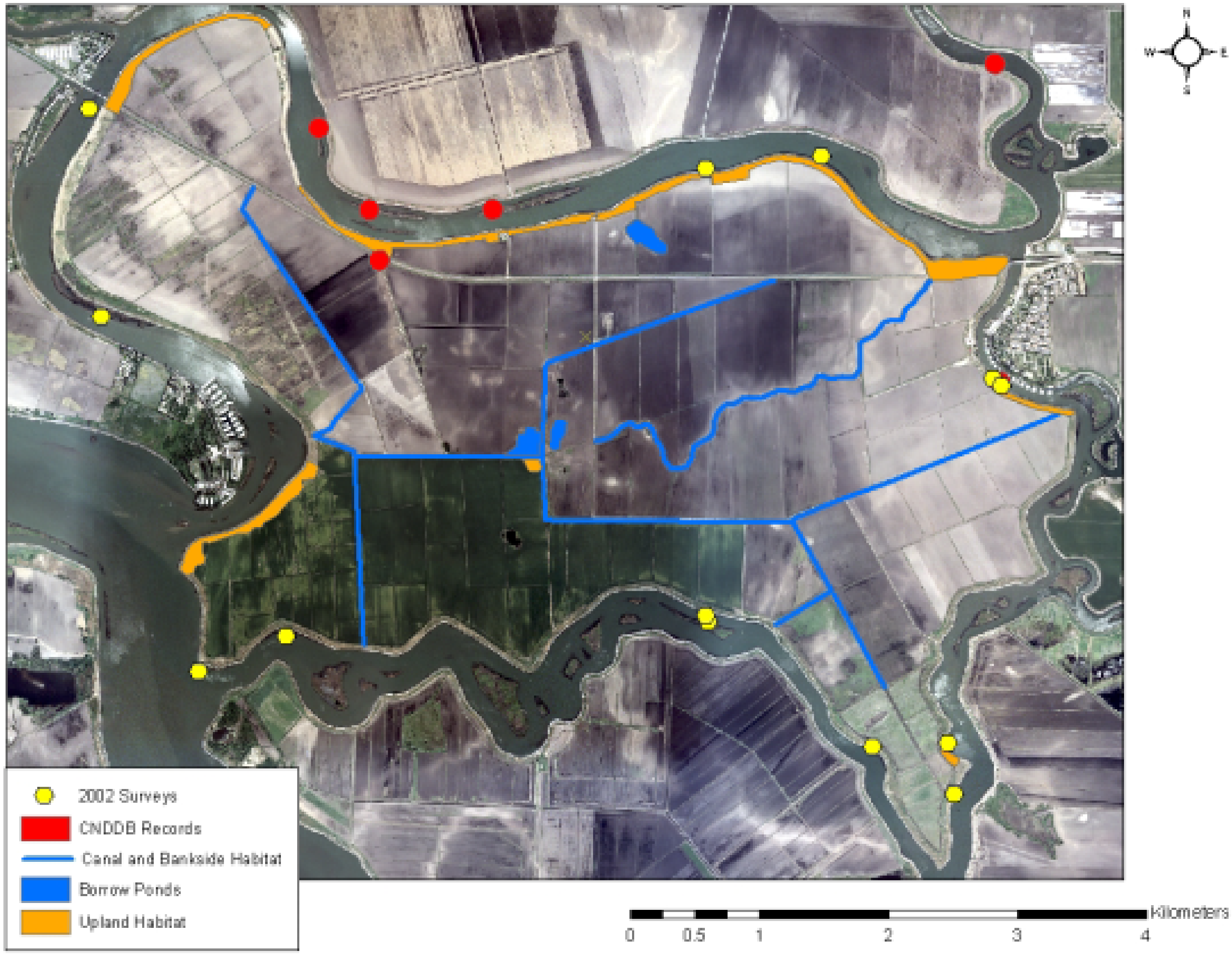
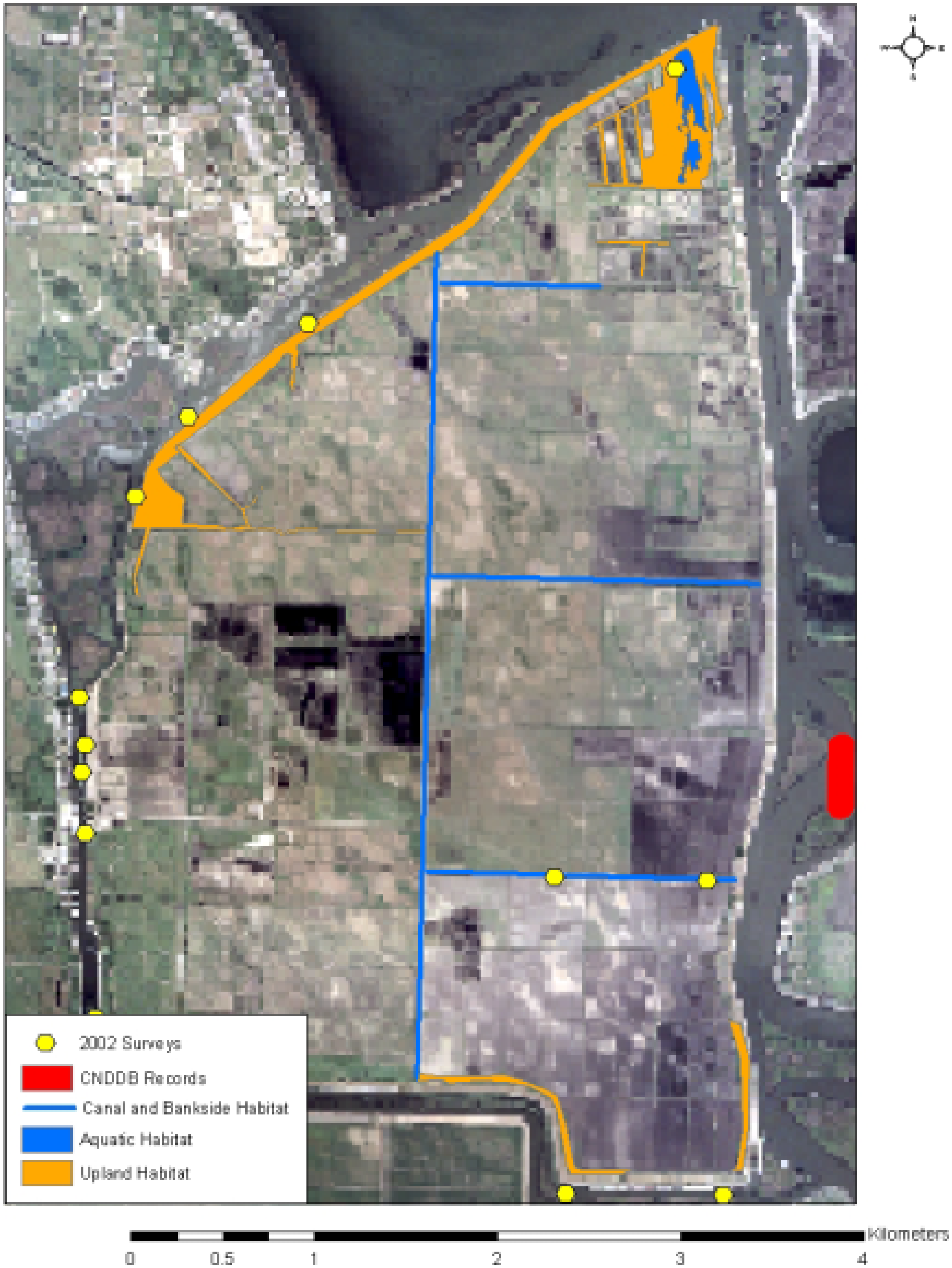


Figure 5-9. Holland Tract Western Pond Turtle Occurrences and Habitat



Greater Sandhill Crane

There are three subspecies of sandhill crane that migrate each fall to the Central Valley of California to spend the winter, the lesser (*G.c canadensis*), Canadian (*G.c. rowani*), and greater (*G.c. tabida*). The greater sandhill crane was classified as a State Threatened species in 1983 under the California Endangered Species Act.

The Central Valley population is one of five distinct greater sandhill crane populations. Central Valley population cranes breed in northeastern California, central and eastern Oregon, southwestern Washington, and southern British Columbia, and migrate to California's Central Valley for the winter. Pogson (1990) recorded 5,129 greater sandhill cranes and Canadian cranes wintering in the Delta in January 1984. This means that over 61% of the Central Valley population of 8,500 (Littlefield and Ivey 2000) greater sandhill cranes used the Delta in 1984. In 1984 the majority of cranes in the Delta were located in the Thornton region, where 3,829 (45% of the population) cranes were observed. The major crane use areas in the Delta include the Woodbridge Ecological Reserve, Staten Island and the Cosumnes River Floodplain. These areas accounted for over 86% of the greater sandhill crane use in January 1984 (Pogson 1990).

Greater sandhill cranes start arriving in the Central Valley in mid-to-late September, but most arrive between mid-October and late November. Pogson (1990) observed a shift in cranes from the Sacramento Valley to the Delta in November and December 1983. The Sacramento-San Joaquin Delta is one of two most important areas in the Central Valley for greater sandhill cranes (Pogson 1990).

Littlefield and Ivey (2000) reported that wintering habitat for greater sandhill cranes consists of secure roosting and loafing habitats close to grainfields. Also, cranes roost in shallow, open water and obtain carbohydrates from grain crops, and protein, calcium and other nutrients from grassland, pastures and alfalfa. Cranes leave night roost early in the morning to feed in grain fields. In the mid-day cranes usually loaf and occasionally feed in pastures, alfalfa fields, along canals, levees, ditches, and dikes or use the shorelines or shallows of ponds, lakes, or other wetlands. In mid-afternoon cranes return to grainfields for feeding. Cranes return to roosting areas in the early evening.

There is little published data on crane use on In-Delta Storage Project islands. Jones and Stokes biologists conducted several crane surveys on Bouldin Island for the DW Project:

- Ground surveys in February 1989 to May 1989 and October 1990, and

∉ Aerial surveys in November 1988, December 1989 to May 1989.

Biologists found an average of 84 (n=4) greater sandhill cranes on Bouldin Island in February 1989 and an average of 1 (n=2) greater in March 1989 during ground surveys. Results from the aerial surveys showed an average of 33 (n=3) in November 1988, 106 (n=5) in December 1989, 29 (n=3) in January 1989, 27 (n=4) in February 1989. JSA (1995a) found 1 crane on Webb Tract during 1989 surveys.

DWR staff conducted sandhill crane surveys on the In-Delta Storage Project islands from September 2002 - February 2003.

Survey Objectives

∉ Estimate the number of greater and lesser sandhill cranes that winter on In-Delta Storage Program Islands

∉ Determine habitat types used on project islands

Methods

Sandhill crane surveys for the In-Delta Storage Project islands followed the methods described in Pogson (1990). The author conducted 22 roadside surveys from the end of September 2002 to the first week of February 2003. I conducted six surveys on Webb Tract and Bouldin Island and five surveys on Bacon Island and Holland Tract. I counted cranes from levee and main roads on the four islands. Survey dates and locations are shown in Table 5-5.

The author searched the entire project island once each survey for cranes by stopping every 0.5-2 km and scanning for cranes with binoculars or a spotting scope. The number of observations and specific observation points varied and were determined by the location and density of cranes, visibility, vegetation, and island configuration. Specific observations were made in each grainfield or similar habitat type that contained cranes. Landscape features (i.e. roads, ditches, and vegetation) were used to define the area included in each observation. An observation number was recorded on a map to keep track of area surveyed. Observations were made from specific locations that provided the clearest views without disturbing cranes.

The author counted cranes by subspecies at each location present and recorded habitat types. I counted greater and Canadian cranes as one subspecies because they are not always distinguishable in the field. I distinguished lesser sandhill cranes from the "Large" cranes by their small body size, shape of their heads, the length and shape of their bills, and the length of their bills relative to the size of their heads. I was unable to determine subspecies of some cranes because they were too far from the observation point or were obscured by vegetation; I counted these cranes as "unknown".

There is the possibility that I counted some cranes twice. For example, cranes may have flown from an area on the island that was previously counted to an uncounted area. However, it is equally likely that some cranes flew away before being counted. Also, it is equally likely that cranes flying could have come from a different island. In instances when counted cranes were observed flying into an uncounted area, the counted cranes were subtracted from the total. The number of cranes counted during each survey is an estimate and is not intended to be an absolute value.

Table 5-5. Dates of winter crane surveys for 2002-2003.

Survey Period	Bouldin Island	Webb Tract	Bacon Island	Holland Tract
1	9/30	-	10/3	10/2
2	10/15	10/18	10/17	-
3	11/12	11/14	11/15	11/13
4	11/25	11/26	-	-
5	-	12/10	-	12/11
6	1/21	1/23	1/24	1/22
7	2/3	2/4	2/6	2/5

Blank cells indicate no surveys were conducted.

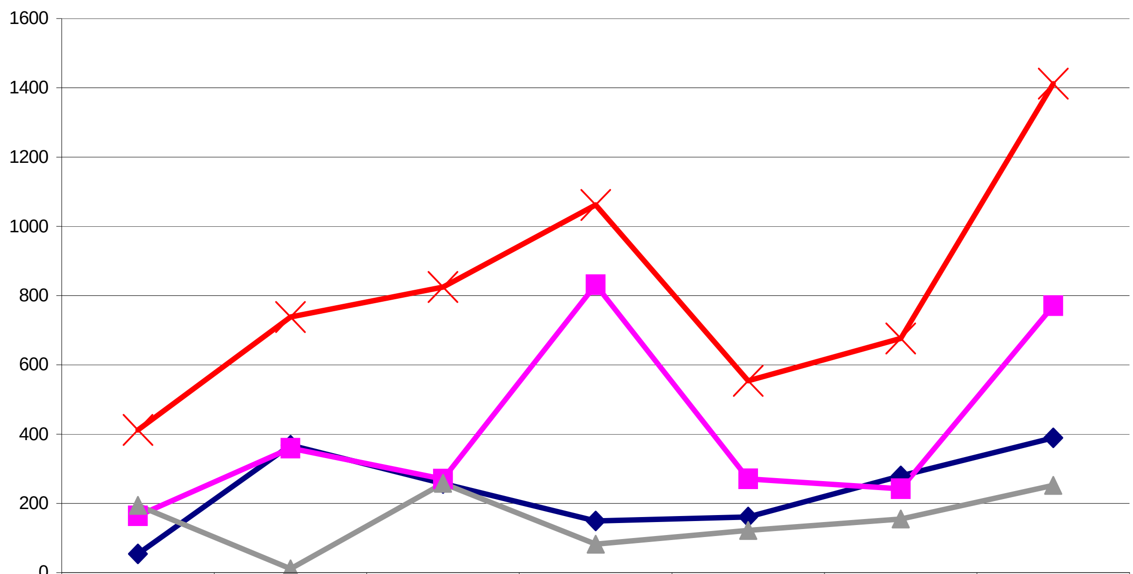
Results and Discussion

Greater sandhill cranes used all project islands through out the 2002-03 fall and winter. The number of cranes observed for each survey period is presented in Figure 5-10. The number of cranes on the project islands increased through the end of November, dropped in December and January, and reached the maximum number observed for the season in February 2003. I observed the maximum number of cranes (1412) and the maximum number of greater sandhill cranes (389) in February 2003. The number of lesser sandhill cranes exceeded the greater sandhill cranes during every survey except two. There were 10 times more lessers than greaters on the project islands in November. The total number of greater sandhill cranes observed on the project islands ranged from 0.64% - 4.58% of the Central Valley population.

The number of cranes that use each island varied from island-to-island and varied through the season (Figure 5-11). The average number of cranes I observed during the 2002-03 surveys was 653.5 (SE = 91.0) on Webb Tract, 201.8 (SE = 59.2) on Bouldin Island, 60.6 (SE = 39.8) on Bacon Island, and 60.8 (SE = 47.4) on Holland Tract. As expected, cranes were more abundant on the northern project islands (Webb & Bouldin) than the southern project islands (Bacon & Holland). Ninety-one percent on average of the sandhill cranes counted occurred on Webb and

Bouldin and about 9% on average occurred on Bacon and Holland. Webb and Bouldin are much closer than Holland and Bacon (about 8 and 10 miles, respectively) to traditional crane roosting locations on Staten Island and the Thornton area. Cranes have roosted in these traditional sites for at least 30 years (Littlefield and Ivey 2000).

Figure 5-10. Number of sandhill cranes counted on Project Islands from September 2002 - February 2003.



	1	2	3	4	5	6	7
Greater	54	368	257	149	161	279	389
Lesser	164	359	270	831	271	242	771
unknown	194	11	258	82	122	155	252
Total	412	738	825	1062	554	676	1412

The numbers of large sandhill cranes counted were significantly greater on Webb Tract than Bouldin Island ($P < .05$), although Webb Tract is approximately 3 miles from Staten Island and Bouldin Island is adjacent to the south side of Staten Island. Webb Tract contained 69% of the large cranes on average each time it was surveyed, while Bouldin contained 35% each time it was surveyed. A possible reason for the larger number of cranes on Webb Tract is that they were roosting on the island. A large open area on Webb Tract was flooded in the winter 2002-2003 (Figure 5-12). The flooded area provided habitat for numerous waterfowl species, and sandhill cranes were frequently observed around this area. Webb Tract's land manager reported hearing cranes at night during the 2002 - 2003 winter (J. Winter personal communication; see "Notes"). This suggests that cranes were roosting on the island.

Figure 5-11. Number of Sandhill Cranes Observed on each Project Islands Winter 2002-2003.

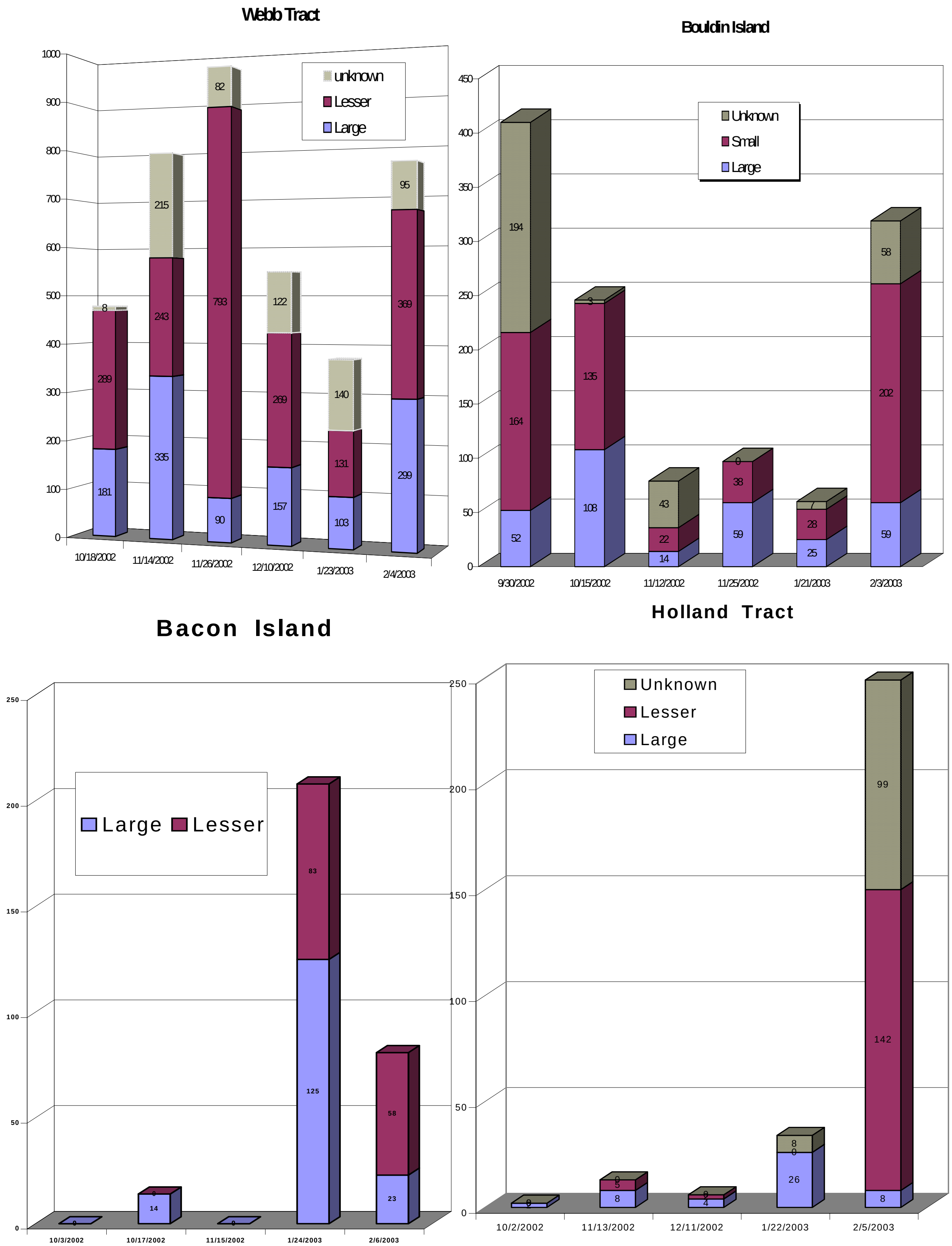


Figure 5-12. Seasonal Managed Wetlands on Webb Tract Winter 2002-2003.

Crane use on Bacon and Holland was minimal in the early part of the season, but increased during January and February. Approximately 95% and 93% of all cranes observed on Bacon and Holland, respectively, were there in January and February. A relatively small number of cranes used both Holland and Bacon during the winter of 2002-03. If the cranes roosted on Staten Island they would have to fly 16-20 miles round trip to forage on Holland and Bacon. No cranes were reported on Holland and Bacon by JSA during surveys for the Delta Wetlands Project in 1988.

Sandhill cranes were observed using six different habitat types on the project islands. The farmers on Bouldin, Webb, and Bacon manage the islands primarily for row crops. The habitat types and the average percentage of use by greater sandhill cranes are shown in Figure 5-13. Corn and wheat were the main crops grown on Bouldin and Webb in 2002. There was also a substantial amount of grasslands and seasonal managed wetlands on Webb Tract. Seasonal managed wetlands were flooded harvested wheat fields or fallow fields with constructed levees. The main crops grown on Bacon Island included corn, wheat, sunflower, potato, and asparagus. Many of the fields on Bacon were immediately disced and leveled after harvesting. Crops were not planted on Holland Tract during 2002; it was managed as pasture for livestock grazing. A portion of the pasture on Holland Tract was flood irrigated through the fall.

Greater sandhill cranes were observed foraging predominately in wheat and cornfields (78%). There was no significant difference between the number of greater sandhill cranes foraging in wheat or cornfields. Grassland habitats were also used on average 18% of the time. The remaining habitats were only used about 4% on average.

Figure 5-13. Percent of Greater Sandhill Cranes Observed by Habitat Types - Winter 2002-2003

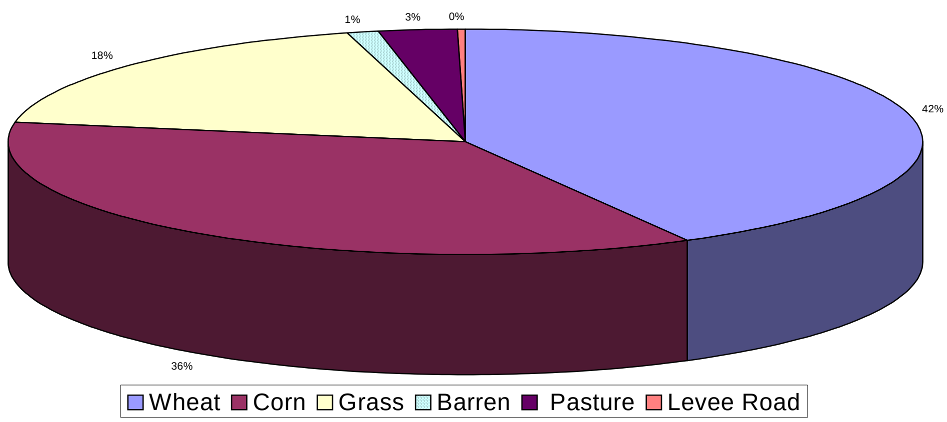


Figure 5-14 illustrates that greater sandhill cranes used wheat fields heavily in the fall and less through the winter. The percentage of cranes using cornfields peaked in the 4th survey period, dropped in the 5th survey period, then came back up in the last survey period. The overall trend for greater sandhill cranes using cornfields showed an increase from fall through the winter. A regression analysis (Figure 5-15) suggests that there was a positive relationship between the percentage of greater sandhill cranes foraging in cornfields (R^2 = 0.6951) and the survey period. Another regression analysis suggests that there is a negative relationship between the percentage of greater sandhill crane foraging in wheat fields and the survey period (R^2 = 0.6947).

Grasslands were used throughout the season. Grassland habitats included levee slopes, areas at the base of the levee that were not in agriculture, and patches of grass growing between agriculture fields. A few cranes on Webb Tract were observed in areas that had been flooded but were drained and had no vegetation. Two greaters were observed on Bouldin Island's levee road in an area covered with gravel, an important source of grit for cranes (Littlefield and Ivey 2000).

Figure 5-14. Greater Sandhill Crane Habitat Use by Survey Period.

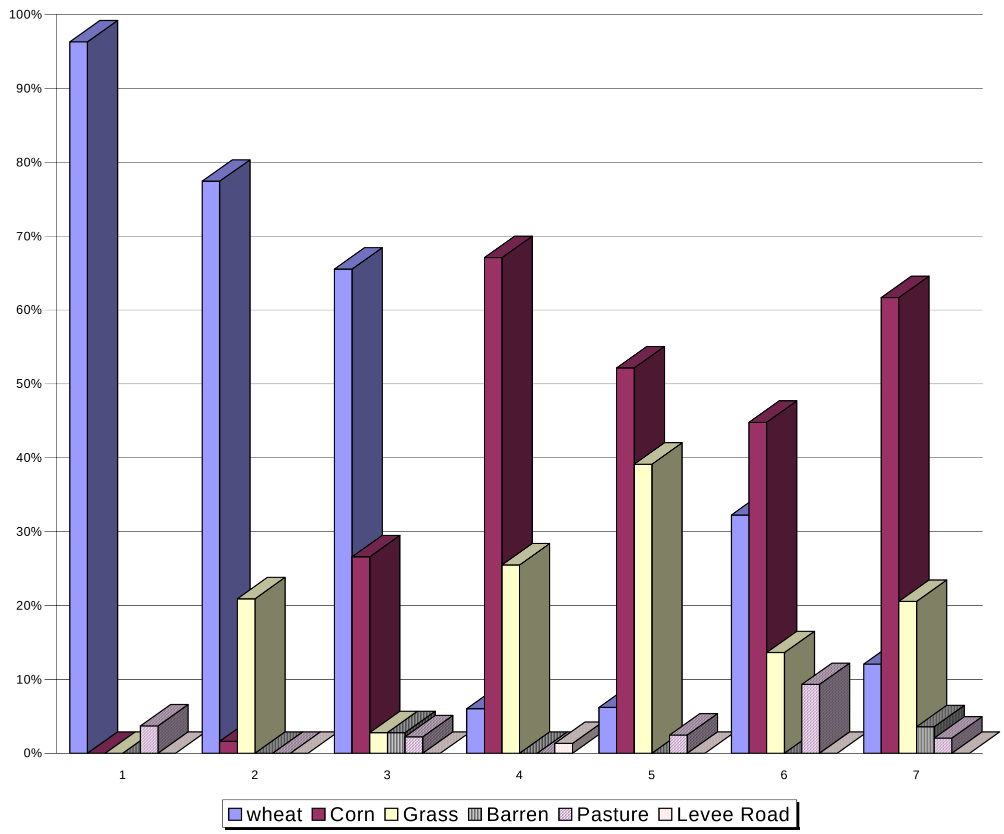
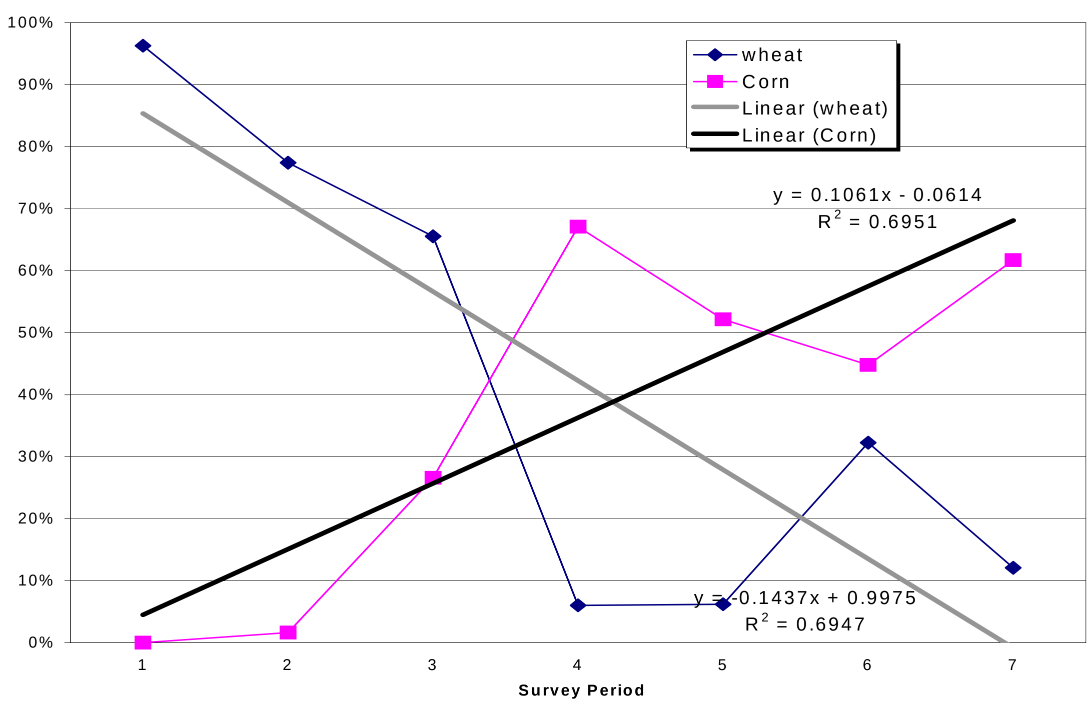


Figure 5-15. Regression Analysis of Crane Use of Corn and Wheat.



The information presented in Figures 5-13 and 5-14 indicates that the availability of grains for forage throughout the winter is important for meeting the greater sandhill cranes needs on the In-Delta Storage Project islands. Furthermore, the importance of grains along with diverse habitat types, such as seasonal wetlands, grasslands and pasture, should be considered in the development of compensation objectives for the greater sandhill crane.

Potential Impacts

Methods

The amount and type of suitable sandhill crane habitats that would be lost from implementing the In-Delta Storage Project were determined from the 1995 & 1996 DWR Land Use (DWR 2002) and the 1987 habitat information presented in the DW Project Environmental Impact Report and Environmental Impact Statement (JSA 1995a), and the revised Habitat Management Plan presented later in this chapter. Suitable crane habitat types listed in the 1995 HMP were used for this analysis (JSA 1995b). The 1987 habitat information was used to modify 1995/96 land use data to more accurately reflect habitat conditions in the following situations:

- The 1987 figures for water surface were used because the 1996 data did not include canals.
- Riparian vegetation was increased on all islands except Holland because the 1996 data did not include many areas that were present in both 1987 and 2002. These figures are estimated from the 1995 & 1996 DWR Land Use Maps and 2001 aerial photographs.
- Developed acres were increased to 1987 figures because the 1996 data did not include highways and other areas that are currently present and were present in 1987.
- Native Vegetation was reduced by the amount added to water surface, riparian, and developed acres.

There is still a large amount of variability between the 1987 and 1996 figures and this analysis is an estimate based on the best available information.

The amount of corn available for forage that would be lost on the reservoir islands from implementing the In-Delta Storage Project were determined based on 1996 habitat conditions. We determined the amount of corn available for forage in 1996 by multiplying the mean pounds per acre figures presented in 1991 Preliminary Draft Habitat Evaluation Procedures (HEP) Report for the Delta Wetlands Project (Table 2-4) by the acres of corn grown 1996. We assumed that the same ratios of disced to undisced fields presented in the HEP occurred in 1996.

The pounds of forage corn lost on the habitat islands from implementing the revised HMP were determined for 1996 habitat conditions by:

- Calculating the percentage of suitable habitat lost,
- Assuming all suitable habitats would be reduced by the same percentage,
- Determining the pounds of forage corn present in 1996 (the same method as used in the Reservoir Islands analysis).

The amount of wheat available for forage that would be lost on the reservoir islands from implementing the In-Delta Storage Project was estimated based on 1996 habitat conditions. We assumed that 52 pounds of wheat per acre would be available for forage. This is equivalent to 1 bushel of wheat (dry weight) per acre that would be left in the field after harvesting (Hirning et al 1987, Ogburn and Donald 1983). We did not differentiate the amount of forage available between disced and non-disced fields. We estimated the pounds of wheat lost on the Habitat Islands from implementing the revised HMP by using the procedures from the corn analysis.

Results

Potential impacts to greater sandhill cranes were determined by evaluating the 1995/96 habitat types and available forage on the project islands and comparing it to the habitats and available forage that would be developed on the habitat islands. We used the 1995/96 DWR Land Use data presented in the 2002 In-Delta Storage Program Draft Report on Environmental Evaluations (DWR 2002) for this analysis because they are the best available information. The impact to different sandhill crane habitats is presented in Table 5-6. Corn and wheat account for 89% of the habitat type being lost on the project islands. The DWR land use category Native Vegetation consists of mostly non-native grasses located on the interior levee and at the base of levees. Seasonal managed wetlands were present on Webb Tract during the 2002-2003 winter (Figure 5-12). These areas were included as wheat or corn in the DWR 1996 land use data. Flooding the reservoir islands would eliminate all habitat types used by sandhill cranes for a total of 8,554 acres. Implementing the revised HMP would eliminate 5, 848 acres of greater sandhill crane habitat on the habitat islands and 1,116 acres of this would be replaced with habitat types (i.e. emergent wetlands, riparian vegetation, and permanent ponds) that are not suitable for cranes. Suitable habitats added to the habitat islands include 2,860 acres of alfalfa for Swainson's hawks and 1,339 acres of herbaceous uplands for giant garter snakes. There are a total of, 10,595 acres of sandhill crane habitat that would be lost from implementing the In-Delta Storage Project. There was an increase of 2,624 acres (38%) in 1996 from the suitable crane habitat available in 1988.

Table 5-6. Acres of Sandhill Crane Habitat Impacted

Acres Lost						
Island Type	Wheat	Corn	Other Grains	Idle/fallow	Native Vegetation	Total
Reservoir	2,772	4,948	71	130	633	8,554
Habitat	1,266	3,588	991	3	0	5,848
Total	4,038	8,536	1,062	133	633	14,402
Acres of Suitable Habitat Added						
Island				Alfalfa	Herbaceous Uplands	
Bouldin				1925	543	2468
Holland				935	404	1339
Total				2860	947	3807
Net Acres lost						10,595

The ratio of crane habitat would shift from grains to alfalfa/grasslands under the In-Delta Storage Project. In 1996 grains accounted for about 92% of the suitable crane habitat, while grasslands and fallow areas comprised about 8% of the habitat. Under the In-Delta Storage Project suitable crane habitat would be comprised of 34% grains and 66% alfalfa/grasslands.

The loss of forage, specifically the loss of corn and wheat, could be used to measure the impacts on crane foraging. Several reports suggest that increased use of sandhill cranes in the Sacramento-San Joaquin Delta is the result of increased production of corn and other grain products (Pogson 1990, Littlefield and Ivey 2000, 2002). Looking solely at the acres of grain lost does not fully illustrate the forage impacts to sandhill cranes. What is available for cranes to consume is also important. Different farming practices determine how much waste grain is available for cranes and other wildlife species to consume. Cranes look for waste grain on the soil surface, thus discing soils, removing stubble, and flooding grain fields reduces the amount of grains available for forage (Littlefield and Ivey 2000). The amount of corn and wheat that would be lost from implementing the In-Delta Storage Project is presented in Table 5-7. About 1.3 million pounds of corn and about 210,000 pounds of wheat would be lost on the project islands.

The In-Delta Storage Project would acquire 3,900 acres of conservation easements for Swainson's hawks. The objective of the conservation easements is to convert low quality Swainson's hawk habit, such as corn, to harvested alfalfa and wheat. This potentially can further reduce the amount grains available for forage. As corn and wheat crops are reduced in the Central Valley, the importance of the grain crops in the Delta for sandhill cranes becomes more important.

Table 5-7. Pounds of Grain Impacted

Crop	Islands	Acres In 1996	Pounds Available for forage	Pounds per acre	Acres Lost	Total Pounds Lost
Corn	Reservoir	4948	891,132	180.1	4948	891,132
	Habitat	4033	437,223	108.4	3588	388,991
Total		8981	1,328,355	147.9	8536	1,280,123
Wheat	Reservoir	2772	144,144	52	2772	144,144
	Habitat	3086	160,472	52	1266	65,832
Total		5858	304,616	52	4038	209,976

Swainson's Hawk

Swainson's hawks (State listed Threatened) occur throughout the Sacramento-San Joaquin Rivers Delta, with concentrations in the north and south Delta. The central Delta has a reduced density by comparison, probably resulting from the poor usability of the crops grown there. Swainson's hawks in California's Central Valley have become reliant on specific crop types with specific cultivation practices; the species has all but abandoned its historic use of grassland habitats. All four of the Delta Wetlands Islands provide usable foraging habitat for Swainson's hawks, which is indicated by the number of Swainson's hawk nests located on or adjacent to each island (Figures 5-15 and 5-16).

Nesting Surveys

Nesting surveys were completed in 2002 and 2003, although they were not protocol level surveys. Even so, 3 nest sites and 2 nest territories were identified on Webb Tract and 2 nest sites and 2 nest territories were identified on or immediately adjacent to Bacon Island (Figure 5-16 and 5-17). The replacement of nest trees/sites will be achieved in the required replacement of wetland habitat components, and no additional mitigation for nesting is expected with the potential exception of additional trees planted along fields well away from wetland areas.

The observed nest sites are in close proximity to 100% of the available forage on both reservoir islands and thus all available foraging habitat would be subject to mitigation under DFG guidelines for Swainson's hawk mitigation.

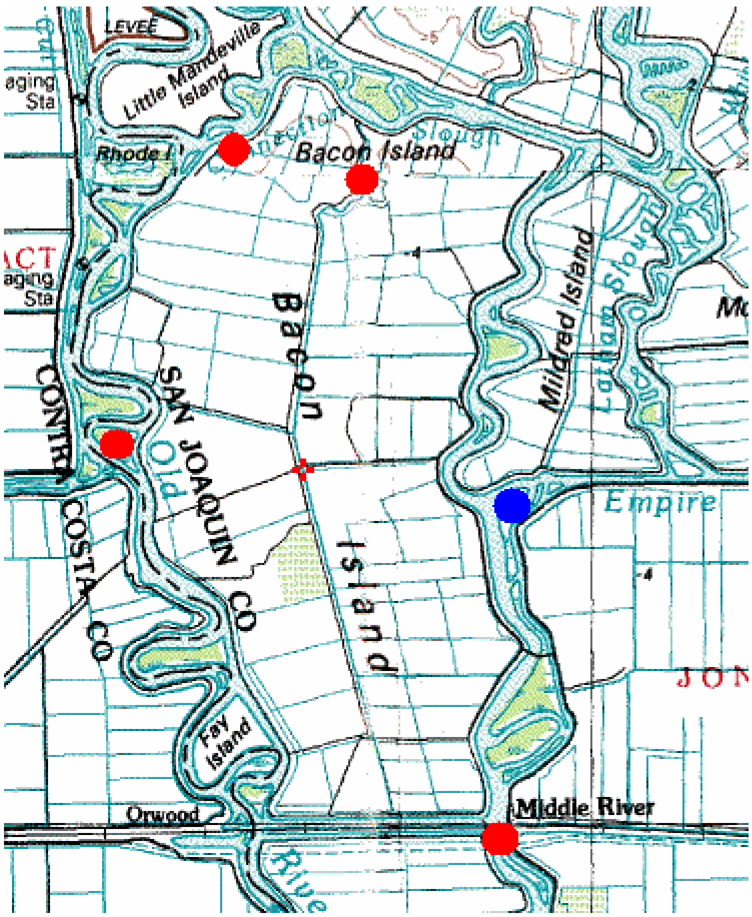


Figure 5-16. Swainson's hawk nests identified on or near Bacon Island in April 2002 (Red dots indicate established nesting territories. The blue dot indicates a sighting of an individual Swainson's hawk. We could not confirm establishment of a nest at the blue dot location later in the season because of funding limitations.)

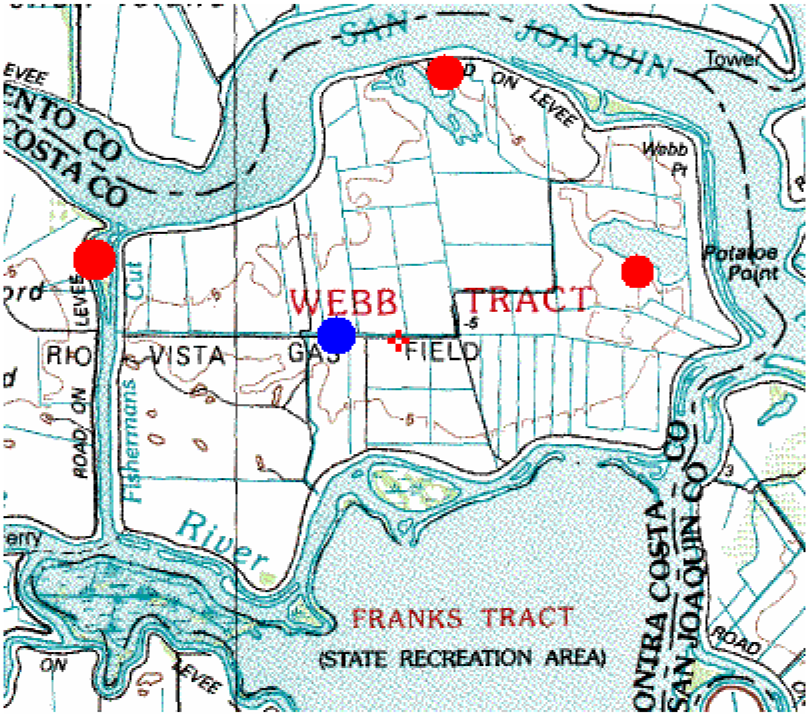


Figure 5-17. Swainson's hawk nests identified on or near Webb Tract in April 2002 (Red dots indicate established nesting territories. The blue dot indicates a sighting of an individual Swainson's hawk. We could not confirm establishment of a nest at the blue dot location later in the season because of funding limitations.)

Habitat Assessment

The Delta Wetlands Project includes four central Delta islands: two reservoir islands which have approximately 5310 acres and 5032 acres of Swainson's hawk foraging habitat (Bacon Island and Webb Tract, respectively); and two habitat (mitigation) islands which have approximately 5653 acres and 2868 acres of Swainson's hawk foraging habitat (Bouldin Island and Holland Tract, respectively). The total amount of Swainson's hawk foraging habitat on the 4 islands is 18,863 acres as determined from DWR's 1996 Land Used Data Base, and which is considered the baseline condition for this project.

The flooding of the two reservoir islands would result in the net loss of 10,342 acres (55%) of Swainson's hawk foraging habitat for all project lands. CEQA requires a finding of significant environmental effect if a State or federally listed species is likely to be reduced in number, and requires mitigation to offset the impact to the greatest extent feasible. The loss of more than 10,000 acres of foraging habitat would likely result in a reduction in numbers of Swainson's hawks in the immediate project area.

Swainson's hawk experts recognize that the loss of gross acres of foraging habitat may be offset by improving the foraging opportunities on mitigation lands. For instance, the loss of 1000 acres of corn (which has little forage value for Swainson's hawks) may be mitigated by replacing a second 1000 acres of corn with alfalfa (which has high forage value), given that the mitigation land is in reasonable proximity to the Swainson's hawk nest sites of concern.

To determine the level of impacts to Swainson's hawks relative to foraging habitat loss on the reservoir islands, the specific crop types typically grown on each island (at 1996 baseline) must also be considered; different crops have differing levels of usefulness by the species (DFG, 1994). Flood-irrigated alfalfa is the crop most used by Swainson's hawks, per unit volume. Alfalfa's 3 to 4 year growing cycle supports large populations of small mammals, especially voles, and flood-irrigation, mowing and baling of the hay makes those prey readily available to the hawk. Recent Swainson's hawk use data indicate that Swainson's hawks use alfalfa 10 to 100 times more often than almost all other crops. (Swolgaard, 2002 unpublished data). Because of the excellent forage value of alfalfa, it has a value factor of 4.

Although Swainson's hawks use alfalfa at a rate many times that of other crops, the increase in value of any crop is greatly limited by the reduction in the size of the foraging area, as per the fundamental principals of island biogeography. A linear reduction of land area results in a geometric reduction of prey, based on the number of species and the population of each species. The principals of island biogeography also indicate that increased habitat diversity results in increased numbers of species, which likely increases stability to foraging habitat; a mixture of alfalfa and other high value forage crops would be preferable to alfalfa alone. In addition, a mixture would reduce the potential for the loss of alfalfa grown in other areas of the Swainson's hawk's range due to a significant increase of alfalfa added to the market from project lands.

Crops/land uses that provide good forage opportunities include wheat, tomatoes, and sugar beets (all are given a value factor of 3), while idled land, irrigated pasture, and grassland provide fair forage opportunities (and have a value factor of 2). Those crops and land uses are primarily useful during cultivation, harvest, or undergoing other mechanical disturbance.

Crops such as corn, asparagus, and safflower support few small mammals or are difficult for Swainson's hawks to penetrate in order to reach prey. But because they are cultivated, and because each may be replaced by other more usable crops on a yearly basis, they have a value factor of 1. Crops/land uses such as orchards, vineyards, rice, have little to no forage value for Swainson's hawks as they have almost no cultivation associated with them and/or Swainson's hawk prey are not readily reachable or existing in them; additionally, they are typically long term land uses with little chance that they'll be converted to more usable field crops; their value factor is ½ . Urban/commercial development, marsh and open water habitats have no forage value now or in the foreseeable future, so it receives a value factor of 0.

The number of acres of each crop type on each island was multiplied by its value factor, and the resulting values were totaled to determine the relative forage value of the available upland habitats for Swainson's hawks. The primary purpose of the exercise was to determine the amount and quality of foraging habitat that would be lost on the reservoir islands, and whether that loss could be mitigated by improving conditions on the habitat islands.

Table 5-8. Swainson's Hawk Foraging Habitat on Webb Tract

Crop	Acres	SWHA value factor	SWHA Forage value
Corn	2744	1	2744
Grain	1920	3	5760
Idle	118	2	236
Native Vegetation	250*	2	500
Total foraging acres	5032	Total forage value	9240

*Approximate value excluding road surfaces and unusable vegetation types that were included in category.

Table 5-9. Swainson's Hawk Foraging Habitat on Bouldin Island

Crop	Acres	SWHA value factor	SWHA Forage value
Corn	3521	1	3521
Grain	1832	3	5496
Native Vegetation	300*	2	600
Total foraging acres	5653	Total forage value	9617

*Approximate value excluding road surfaces and unusable vegetation types that were included in category

Webb Tract has 5032 acres of Swainson's hawk foraging habitat at baseline and a total forage value of 9240 for those acres, which will be lost when the island is flooded. Bouldin Island has a foraging area of 5653 acres, which have a current forage value of 9617. The forage value on Bouldin would have to be increased to 18,857 in order to offset the loss of Webb Tract's acreage. This can be achieved by converting an existing 3100 acres of corn to alfalfa, while leaving all other acreage in baseline condition. Other configurations of crops are also possible, as long as a high percentage of acres are planted to alfalfa.

Table 5-10. Swainson's Hawk Foraging Habitat on Bacon Island

Crop	Acres	SWHA value factor	SWHA Forage value
Corn	2206	1	2206
Sunflowers	872	1	872
Grain	852	3	2556
Potatoes	805	2	1610
Asparagus	290	1	290
Native Vegetation	200*	2	400
Sorghum	71	2	142
Idle	14	2	28
Total foraging acres	5310	Total forage value	8104

* Approximate value excluding road surfaces and unusable vegetation types that were included in category

Table 5-11. Swainson's Hawk Foraging Habitat on Holland Tract (project lands)

Crop	Acres	SWHA value factor	SWHA Forage value
Grain	1230	3	3690
Safflower	993	1	993
Corn	514	1	514
Native Vegetation	100*	2	200
Idle	31	2	62
Total foraging acres	2868	Total forage value	5459

* Approximate value excluding road surfaces and unusable vegetation types that were included in category

Bacon Island has 5310 acres of Swainson's hawk foraging habitat and a forage value of 8104. Holland Tract has 2868 acres of Swainson's hawk foraging habitat with a forage value of 5459. Holland Tract's acreage would have to be improved to a forage value of 13,563 to compensate for the loss of forage on Bacon Island. There is no way to improve the current upland crops to give the mitigation portion of Holland Tract a forage value of 13,563. The maximum that could be achieved is a value of 11,072, and that could only be achieved if 100% of the available cropland listed above were planted in alfalfa; a minimum of 850 acres of off-site cropland with a current value factor of 1 would have to be purchased and put into alfalfa in order to reach the target value of 13,563. In addition, the off-site land would have to be immediately adjacent to Bacon Island and/or Holland Tract to adequately serve the nesting hawks in that area. Because Bouldin Island is 6+ miles from Bacon Island, increasing Bouldin Island's forage value would not serve those Swainson's hawks that lost foraging habitat on Bacon Island.

A number of assumptions are made in this analysis that cannot be completely assured: it assumes that a small area with high forage value is equivalent or better than a large area with moderate forage value; it assumes that energetically, all foraging acreage is equally accessible; it assumes that there will be alternative nest trees in close proximity to the improved but smaller foraging area given that many currently available nest trees on reservoir islands will be lost; and finally, it assumes that condensing the current population in the area to a smaller use area will have no additional detrimental effects. Although these assumptions cannot be assured, current knowledge of the species suggest that this mitigation scenario will indeed offset the negative impacts of the project on foraging habitat. Impacts associated with the loss of nest sites will also have to be addressed, but will likely be appropriately mitigated through the replacement of riparian habitat that will be lost on both reservoir islands, and the affected population will not be reduced due to project activities.

California Black Rail

Although black rails occur within the Delta, they require a minimum habitat size of 10-16 acres of a combination of emergent marsh and associated upland vegetation (Holt and Gifford). Additionally, narrow islands of the proper acreage are not useful, they are susceptible to flooding, and foraging distance for rails increases significantly as foraging range changes from circular to elongate.

No instream islands around the project reservoir islands are large enough to support black rail use. Passive surveys for black rail vocalizations were completed around Bacon Island and no black rails were heard. The impacts to the instream islands from projected facility operations is expected to be nominal. No significant impacts to black rails are expected from the project, and no mitigation should be necessary for the species.

Special-Status Bird Surveys

DWR biologists conducted a total of 70 bird surveys on the In-Delta Storage Project islands from April 2002 to February 2003. Table 5-12 lists the number of surveys conducted on each island by month. Habitat specific surveys were conducted for the western burrowing owl, tricolored blackbird and the loggerhead shrike. Specific surveys were not conducted for other special-status species. However, when one was observed it was recorded.

Table 5-12. Number of Bird Survey Conducted each Month

Month	Webb	Bacon	Bouldin	Holland	Total
April	2	1	2	1	6
May	5	3	2	3	13
June	3	2	2	2	9
July	3	2	3	3	11
August	1	2	2	1	8
September	1	1	1	1	4
October	1	2	1	1	5
November	2	1	2	1	6
December	1	0	0	1	2
January	1	1	1	1	4
February	1	1	1	1	4
Total	**21**	**16**	**17**	**16**	**70**

Western Burrowing Owl

The western burrowing owl (*Athene cunicularia hypugaea*) is a California species of special concern because of declines in suitable habitat and declines in local and statewide populations. Burrowing owls are found in open, dry grasslands, agricultural and range lands, and desert habitats often associated with burrowing animals. They can be found at elevations ranging from 200 feet below sea level to 9,000 feet. The owl commonly perches on fence posts or on top of mounds outside its burrow. They are active day and night, but are usually less active in the peak of the day.

In addition to the presence of burrows, burrowing owl habitat suitability in the Central Valley is based on percent vegetation cover, height of vegetation surrounding the burrow, the presence of ground squirrels, soil texture, and the presence of perches. Burrowing owls nest in burrows in the ground, often in old ground squirrel burrows. They can dig their own burrows, but prefer deserted excavations of other animals. They are also known to use artificial burrows.

Owl nesting season begins in late March or April. Burrowing owls may use a site for breeding, wintering, foraging, and/or migration stopovers. Occupancy of suitable burrowing owl habitat can be verified by an observation of at least one burrowing owl, or, alternatively, its molted feathers, cast pellets, prey remains, eggshell fragments, or excrement at or near a burrow entrance. Burrowing owls exhibit high site fidelity, reusing burrows year after year (Trulio 2000).

Methods

We conducted habitat specific surveys for burrowing owls by driving island roads and walking through areas of potential owl habitat. We investigated specific habitat components for the presence of owls by searching for burrows. We monitored areas with burrows during each survey for signs of owl feathers, pellets, prey remains, eggshell or excrement at or near the burrow entrance.

Results and Discussion

Potential nesting and wintering habitat for the western burrowing owls exist on the project islands. However, California ground squirrel burrows are extensive along the interior side of the levees on Holland Tract and Bacon Island. These burrow locations are not ideal for burrowing owls as they are on exposed levee slopes in which vegetation is intensely managed. There were no burrowing owls observed during any of the bird surveys conducted during 2002-03. There were no signs of burrowing owls using abandoned ground squirrel burrows on Holland Tract or Bacon Island during nesting and wintering periods. There were no burrowing owls observed using artificial burrows (i.e. abandoned pipes and culverts) on any of the project islands during the nesting and wintering periods.

Levee vegetation management was intensive on Holland and Bacon in 2002. Levee maintenance activities included discing and grazing, which altered habitat conditions by damaging burrows. JSA biologists observed one burrowing owl on Bacon Island in 1988.

Potential Impacts

Based upon the 2002-2003 surveys there would be no direct loss of burrowing owls. Nevertheless, potential suitable habitat for burrowing owls would be lost on Webb Tract and Bacon Island from flooding the islands. Based upon the 1996 DWR Land Use Data approximately 633 acres of native vegetation would be lost on the reservoir islands. The revised HMP provides for high quality grassland habitat (herbaceous uplands) on the habitat islands, which would compensate for the loss of low-quality levee grassland habitat on the reservoir islands.

Tricolored Blackbird

The tricolored blackbird (*Agelaius tricolor*) is a federal species of concern and a California species of special concern. Predation, habitat loss and alterations, poisoning, contaminants, and human disturbances threaten populations.

Tricolored blackbirds have three basic requirements for breeding colony sites: (1) open accessible water; (2) protected nesting substrate, which is usually either flooded or thorny or spiny vegetation; and (3) suitable foraging space providing adequate insect prey within a few kilometers (km) of the nesting colony.

Tricolored blackbirds predominately nest in freshwater marshes dominated by bulrushes *(Scirpus* sp.) and cattails *(Typha* sp.). The remaining colonies nest in willows *(Salix* spp.), blackberries *(Rubus* sp.), thistles *(Cirsium* and *Centaurea* spp.), or nettles *(Urtica* sp.). An increasing percentage of tricolored blackbird colonies in the 1980s and 1990s were reported in Himalayan blackberries *(Rubus discolor)*, and some of the largest recent colonies are in silage and grain fields. Other substrates where tricolors have been observed nesting include giant cane *(Arundo donax)*, safflower *(Carthamus tinctorius)*, tamarisk trees *(Tamarix* spp.), and poison oak *(Toxicodendron diversilobum)*. In addition, they have been found in habitats that include riparian scrublands (e.g., *Salix, Populus, Fraxinus)* and forests.

Tricolored blackbird foraging habitats include pastures, dry seasonal pools, agricultural fields (such as alfalfa), rice fields, feedlots, and dairies. Tricolors also forage occasionally in riparian scrub, saltbush scrub, marsh borders, and grassland habitats. Weed free row crops and intensively managed orchards and vineyards do not serve as regular foraging sites. Nestlings are mainly fed insects. Adults may continue to consume plant foods throughout the nesting cycle but also forage on insects and other animal foods. Tricolors feed primarily on grains during the winter. This includes rice, other grains, and weed seeds. In winter, tricolors often form mixed flocks with other blackbirds. Flocks as large as 15,000 individuals form and then disperse to foraging sites. Some winter foraging flocks are composed almost entirely of one sex (Beeby and Hamilton 1997).

Survey Objectives

- Determine if any tricolored blackbird nesting colonies are present on the project islands
- Determine if tricolors forage on the project islands

Methods

DWR staff conducted surveys from April through September 2002 to determine if any tricolored blackbird nesting colonies were present on the project islands. Staff conducted habitat specific surveys by monitoring suitable nesting habitats for the presence of tricolored blackbird nesting colonies on all project islands. DWR staff searched for tricolored blackbirds by driving or walking to about 100-feet from potential nesting habitat and listening for calls and observing birds with binoculars and a spotting scope. Staff made observations from behind vegetation or a vehicle, as much as possible. DWR staff also surveyed for foraging male tricolored blackbird flocks by driving along levee and farm roads adjacent to grasslands and grain crops and periodically stopping to scan the area with binoculars and a spotting scope.

DWR staff conducted surveys from October 2002 through February 2003 to determine if any tricolored blackbirds were foraging on the project islands during the winter. Staff monitored winter flocks of blackbirds with binoculars and spotting scope to determine the presence of tricolored blackbirds. When tricolors were observed, the number of tricolored blackbirds in wintering flocks were estimated, the habitat types were recorded and the location was noted on a map.

Results and Discussion

Potential nesting habitat was present on all project islands in 2002 and consisted of emergent marsh, willow scrub, riparian woodlands, Himalayan blackberry brambles, and grain crops. Nesting colonies were not detected on any of the project islands during the 2002 field surveys.

Foraging habitat on the project islands included grainfields, sunflowers, and safflower. Tricolored blackbirds were not observed foraging on the project islands during the spring and summer. Despite the amount of foraging habitat, tricolors were only detected on a few occasions foraging on Bacon Island and Webb Tract during the fall and winter. Tricolored blackbirds were detected foraging in mixed flocks of blackbirds most often. In addition to tricolored blackbird, the mixed flocks usually included red-winged blackbirds, European starlings, and yellow-headed blackbirds. Tricolored blackbirds were not observed during the 1988 surveys for the Delta Wetlands Project.

I first observed tricolored blackbirds foraging for invertebrates in the soil of a wet harvested field on the northeastern section of Bacon Island in early October 2002. Tricolors were first observed in early October 2002 on the northeastern section of Bacon Island foraging for invertebrates in the soil of a wet harvested field. I detected large flocks of mixed blackbirds foraging in recently harvested sunflower fields in mid-October 2002. The mixed flocks included thousands of individuals and moved continuously, which made it difficult to estimate the number of tricolors. I observed approximately 200-300 tricolors foraging on the soil surface. I also observed a flock of about 50 male tricolors flying back and forth from the sunflower fields to bulrushes growing on the riverside of the levee on the east side of Bacon. I observed tricolors along the northwestern side of Bacon in November 2002, January and February 2003. Tricolors were with mixed flocks foraging in harvested sunflower fields and cornfields during every observation on the northwestern side of Bacon Island. Occasionally a few to several individuals of the mixed flock would fly to the bulrushes and trees on the riverside of the levee to rest for a few minutes then fly back to the fields to forage.

In January and February 2003, I observed tricolored blackbirds on the south side of Webb Tract foraging in harvested cornfields. An estimated 20-30 tricolored blackbirds were in a mixed flock of about 200-300 blackbirds. I observed tricolors only on the south side of Webb Tract on two occasions despite the uniformity of habitat types throughout the island.

Potential Impacts

DWR staff did not observe tricolors foraging on the habitat islands during the 2002-2003 surveys. However, large flocks of foraging blackbirds were observed on Bouldin Islands and Holland Tract. Since tricolors were observed on Webb and Bacon, it is likely that they also occurred on Bouldin Island because of the similar crop types. Crops were not planted on Holland Tract during 2002, so grains were not available for foraging during the winter.

The size of the foraging area for tricolored blackbirds is dependent upon the unpredictable abundance of insects from the nesting location. Although no nesting colonies or foraging tricolors were observed during the spring and summer, impacts may occur under some conditions, since the foraging radius can be up to eight miles from the nesting location (Cook 2002, personal communication; See "Notes"). Additionally, flooding the reservoir islands will result in the loss of potential winter foraging habitat for the tricolored blackbirds. The amount of potential habitat lost will be variable and be dependent upon the amount and type of crops that are planted and the farming practices that are implemented after harvesting (e.g. tilling and clearing fields of waste material or flooding). Based upon the 2002-2003 surveys, impacts to tricolors from flooding Webb Tract will be minimal because a relatively small number of tricolors foraged on the island. The potential impact on tricolored blackbirds from flooding Bacon Island could be substantial. Flocks with thousands of individual blackbirds were observed on Bacon Island during and immediately after sunflower harvest. Also, tricolors foraged on Bacon Island through the entire winter.

Levee improvements will probably eliminate vegetation growing along the outside levees where tricolored blackbirds were observed resting. This impact will be minimal because it is unlikely that tricolors will use the narrow strips of vegetation if there is no adjacent foraging habitat.

The high-quality diverse habitat types including grains, grasslands, alfalfa and nesting substrates that are proposed in the revised HMP should compensate for the loss of tricolored blackbird habitat on the reservoir islands.

Loggerhead Shrike

The loggerhead shrike (*Lanus ludovicianus)* is a federal species of concern and a California species of special concern. Loggerhead shrikes require open grassland or agricultural areas with scattered shrubs or small trees for perching, hunting, and nesting. Nesting shrubs and trees can be loosely scattered, arranged in a linear or grid fashion, or isolated. Typical habitats include fallow fields and other idle grassland fields, pastures, open savannas, farmsteads, parks, golf courses, cemeteries, and roadsides with shrubs, saplings, and small trees. Shrikes also use areas of open cropland with adjacent hedgerows, fences, shrubs, or saplings. They frequently use utility wires for perching. Shrikes require at least one shrub, sapling, or small tree, typically with dense foliage, for perching, hunting, and nesting. Thorny or spiny shrubs and trees are preferred as they can be used for impaling prey; barbed wire fences are also used for this purpose. Shrikes tend to prefer habitats with grasses and forbs of relatively short to medium height and some bare ground for hunting (Yosef 1996).

Methods

DWR staff conducted habitat specific surveys for loggerhead shrike on the In-Delta Storage Project islands by driving and walking on levee and main roads adjacent to loggerhead shrike habitats. Staff searched herbaceous and riparian habitats and monitored with binoculars and a spotting scope to determine the presence of loggerhead shrike. Staff recorded the number of shrikes observed and mapped and numbered observation locations.

Results and Discussion

DWR staff observed shrikes on all In-Delta Storage Project islands through the spring, summer, fall and winter (Figure 5-18). DWR staff did not observe any shrikes in April 2002 on any of the In-Delta Storage Project islands. The primary loggerhead shrike habitat on the project islands is on interior levees that contain utility lines or fences. Loggerhead shrikes were observed only in areas with above ground utility lines located near levees on Webb Tract, Bouldin Island and Bacon Island. Shrikes perch on the utility lines to locate prey on the ground. Shrikes generally move up and down the levees hunting for prey.

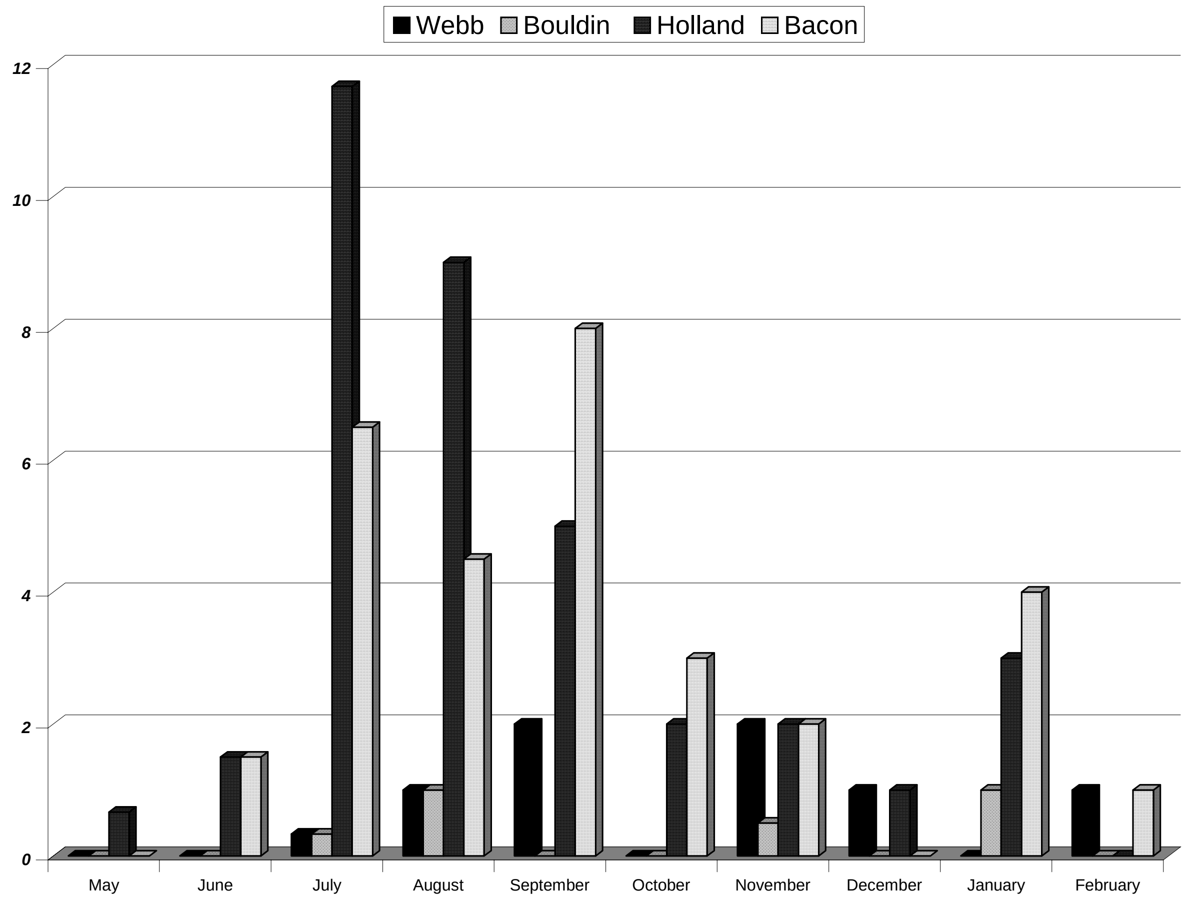
Holland Tract's pasture (with fences and utility lines), riparian habitat, rows of trees and blackberry shrubs provide foraging and nesting habitat across the island. Shrikes were observed during the entire survey period on Holland. DWR staff observed the highest monthly average of shrikes (11.7) and the highest number (19) in July on Holland Tract. Staff conducted only one survey each month on Holland Tract from August 2002 to February 2003. The number of shrikes declined on Holland starting in August and continued through December. The number of shrikes seen in January 2003 was slightly higher than in December 2002. During the February 2003 survey, access was limited to the levee road because sandhill cranes were foraging across the island.

Utility lines are located at the base of the levees around Bacon Island. Shrikes were observed on the levees around the entire island, except in developed areas, such as houses and warehouses. DWR staff observed the highest number of shrikes in July, August, and September on Bacon Island. The number of shrikes dropped in October and remained low through February 2003. There are suitable nesting trees located intermittently around Bacon Island.

There was a difference in the number of shrikes that used the southern islands compared to the northern islands. Ninety percent of the loggerhead shrikes observed on the In-Delta Storage Project islands occurred on Holland Tract and Bacon Island. DWR staff counted only eight shrikes during 6 different surveys on Webb Tract. Also, DWR staff observed only five shrikes on 4 different surveys on Bouldin Island. Staff did not observe more than two shrikes per survey for both Webb Tract and Bouldin Island. Utility lines are located at the base of levees on Webb Tract, as on Bacon Island, however the number of shrikes observed was much lower. On Bouldin Island the above ground utility lines are located mostly along the northern and western levees.

JSA biologist observed loggerhead shrikes only on Webb Tract during the 1988 surveys for the Delta Wetlands Project. JSA biologist observed an average of 3.5 shrikes (n=5) per survey during four surveys in February and one survey in March 1988 on Webb Tract. DWR staff observed an average of 4.3 (n=16) shrikes per survey on Holland Tact, 2.9 (n=16) on Bacon Island, 0.4 (n=21) on Webb Tract, and 0.3 (n=17) on Bouldin Island from April 2002 to February 2003.

Figure 5-18. Average Number of Loggerhead Shrikes Observed Per Month on In-Delta Storage Project Islands, May 2002 - February 2003



Potential Impacts

Potential impact to the loggerhead shrike foraging habitat would occur from flooding Bacon Island and Webb Tract. Based upon the 1996 DWR Land Use Data approximately 633 acres of native vegetation would be lost on the reservoir islands. In addition, foraging habitat for the loggerhead shrike would be lost on Holland Tract by converting pastures to wetlands and crops under the revised HMP. The revised HMP will provide high quality grassland habitat (herbaceous uplands) and preserve shrubs and scattered trees on the habitat islands. This will compensate for the loss of low-quality levee grassland habitat on the reservoir islands and pasture on Holland Tract.

Other Special-Status Species

DWR staff periodically observed other special-status bird species when conducting the bird surveys described in the previous sections. Staff did not conduct specific surveys for these species, therefore, survey data are not provided. The list of species seen by Project Island is provided in Table 5-13.

Table 5-13. Special-Statues Bird Species Incidentally Observed on In-Delta Storage Project Islands 2002-2003

Species	Status	Webb	Bacon	Bouldin	Holland
American peregrine falcon	SE	X	X	X	X
American white pelican	CSC	X	X	X	X
California Gull	CSC	X	X	X	X
California horned lark	CSC	X		X	
Cooper's Hawk	CSC	X	X	X	X
Ferruginous Hawk	CSC				X
Northern Harrier	CSC	X	X	X	X
Osprey	CSC	X			X
Rough-legged hawk	FSC/CSC	X			
Sharp-shinned Hawk	CSC			X	
White-tailed kite	FSC	X	X	X	X
Yellow warbler	CSC	X			

SE=State Endangered, CSC=California species of special concern, FSC=federal species of concern

JSA biologist observed all the species presented in Table 5-13 during the 1988 surveys for the Delta Wetlands Project with the exception of the American peregrine falcon, the ferruginous hawk, osprey and the yellow warbler. DWR staff periodically observed the peregrine falcon on the project islands during the winter 2002-2003. Staff observed ospreys during three surveys on Webb Tract and two surveys on Holland Tract in 2002-2003. DWR staff observed the ferruginous hawk one time on Holland Tract during the winter 2003. Staff observed the yellow warbler once in early spring 2002 in riparian woodlands next to a blowout pond on Webb Tract.

The development of a mosaic of diverse habitat types that include wetlands, riparian, grasslands and crops proposed in the revised HMP on the habitat islands would mitigate for the impacts to special-status species.

Bats

DWR staff identified three species of bats as potentially occurring on the In-Delta Storage Project islands in the 2002 Planning Study Report (CALFED 2002). Bat surveys were not done for the 1995 DIER/EIS for the DW Project. DWR staff recommended a bat habitat evaluation be completed for the project islands (CALFED 2002) and the evaluation was completed in late 2002.

The evaluation found that suitable roosting habitat is present on each island in crevices, cavities and foliage found in vegetation and structures. Accessible structures were visually inspected and no roost sites were found. Foraging habitat is present on each island and acoustic surveys at selected sites detected bat activity near water features, riparian vegetation, and open pasture on Bacon Island and Holland Tract. No bats were detected on a single night's survey on Bouldin Island during unfavorable weather. Webb Tract was not surveyed for bat foraging because of access restrictions. Important habitat components were identified including riparian woodlands, lakes and ponds, irrigation canals lined with vegetation, and open pasture with complex vegetation interfaces. Habitat will be lost on Webb Tract and Bacon Island and recommendations are made in the technical memorandum to create or expand important habitat components on Holland and Bouldin islands. Additional focal species surveys were recommended for Webb Tract and Holland Tract because potential habitat is present but preliminary surveys were insufficient to address the presence of specific species. If presence is assumed mitigation in kind (1:1) should be sufficient.

The technical memorandum describing the methods and complete results of the evaluation is included in Appendix C.

Mitigation Requirements and Strategies

The 1995 Draft HMP for the Delta Wetlands Project compensates for the impacts to species and habitats that were identified and assessed in the late 1980's. The 1995 HMP is a living document and allows for adjustments based on species and habitat needs. The 1995 HMP does not provide species specific compensation goal and objectives for the giant garter snake because it was determined that effects on it would be insignificant (USFWS 1997a). Habitat for the Swainson's hawk and the greater sandhill crane has increased on the project islands since 1988. Therefore, as part of the planning process, DWR has developed a revised HMP to compensate for the loss of giant garter snake habitat, greater sandhill crane habitat, Swainson's hawk habitat and jurisdictional wetlands. It is necessary to identify the mitigation that is likely to be required for the project in order to assess the costs and feasibility of the project. The revised HMP is based on the assumption that giant garter snakes are present on the project islands.

The revised HMP would mitigate all impacts to jurisdictional wetlands, giant garter snake, greater sandhill crane and Swainson's hawk nesting habitat and a portion of Swainson's hawk foraging habitat impacts on Bouldin Island and Holland Tract. DWR and Reclamation would acquire conservation easements for any remaining Swainson's hawk foraging habitat mitigation. Implementing the revised HMP will also mitigate for the loss of habitat for other special-status species.

During the subsequent EIR/EIS process additional work will be done to refine the revised HMP to insure that the needs of all listed species are met. The version of the HMP that is ultimately selected will be based on a number of factors, including the results of the giant garter snake presence/absence surveys, input from the resource agencies, the federal and state ESA consultation process, the NEPA/CEQA process, stakeholder review and costs.

Potential Giant Garter Snake Habitat Mitigation

Approximately 458 acres of potential giant garter snake (GGS) habitat on Bacon Island and 657 acres of potential GGS habitat on Webb Tract will be lost if these islands are flooded. At 3:1, 3,345 acres of mitigation will be required on Bouldin Island and Holland Tract (habitat islands). Approximately 2 acres of suitable upland should either be preserved or created for every

1 acre of suitable aquatic habitat preserved or created on the habitat islands. All potential GGS habitat on the habitat islands will either be preserved or improved so no mitigation for impacts to this habitat will have to be provided.

DWR is investigatinf the presence or absence of giant garter snakes on the reservoir islands in 2003 and 2004. The results of this investigation will determine the extent of the actual mitigation required. If the investigation is done to satisfaction of USFWS and DFG and it is determined that giant garter snakes are not present on the project islands no mitigation would be required.

Conducting baseline surveys on the habitat islands is dependent on the results from the reservoir island surveys and input from USFWS and DFG. DWR and Reclamation will consult with the agencies on the management practices that will be used on the habitat island to insure that take is minimized if the islands are colonized by GGS in the future.

Jurisdictional Wetland Mitigation

Table 5-15 depicts jurisdictional wetland habitat types that would have been impacted by the 1995 HMP and the mitigation required under the Department of the Army Permit 190109804 (DA Permit). Jurisdictional wetland habitat types that can function as suitable upland GGS habitat if managed properly are cottonwood willow woodland and great valley willow scrub. Jurisdictional wetland habitat types that can function as suitable aquatic GGS habitat if managed properly are freshwater marsh and permanent pond. Impacts to exotic marsh will be mitigated with creation or preservation of emergent marsh.

Table 5-15. Jurisdictional Wetlands Impacts and Mitigation Requirements According to DA Permit 190109804

Habitat Type	Reservoir Islands (acres)	Habitat Islands (acres)	Total Impacts (acres)	Mitigation Ratio	Required Mitigation (acres)
Cottonwood Willow Woodland	100.4	6.5	106.9	3:1	320.6
Great Valley Willow Scrub	65.9	10.2	76.1	2:1	152.1
Exotic Marsh	102.2	44.7	146.9	2:1	293.7
Freshwater Marsh	70.3	85.1	155.4	2:1	310.8
Permanent Pond	84.7	0	84.7	1:1	84.7

Some of these habitat types currently exist in places that were identified as potential GGS habitat during the habitat evaluations in 2002, and others are located in areas that can be easily avoided during implementation of the revised HMP. Using ArcView 8.2, I calculated the areas of jurisdictional wetland habitat types that did not overlap with any potential GGS habitat and that could possibly change to non-wetland habitat types during implementation of the revised HMP. Table 5-16 depicts the estimates of impact on Bouldin Island and Holland Tract in addition to the impacts on the reservoir islands. It also reports the potential mitigation requirements using the same mitigation ratios as those found in the DA Permit.

Implementing the revised HMP is not expected to impact the remaining acreage of jurisdictional wetlands on the habitat islands. These areas will be incorporated into the design of the new HMP along with the potential mitigation requirements listed in Table 5-16. Table 5-17 depicts the acreage of existing jurisdictional wetland types that are expected to remain under the revised HMP and the amounts of each habitat type that must be provided to meet the potential mitigation requirements.

Table 5-16. Estimated Impacts to Jurisdictional Wetlands on Habitat Islands and Potential Mitigation Requirements under New HMP

Habitat Type	Bouldin Island (acres)	Holland Tract (acres)	Habitat Islands Total (acres)	Reservoir Islands Total (acres)	Potential Mitigation (acres)
Cottonwood Willow Woodland	0	0	0	100.4	301.2
Great Valley Willow Scrub	0	1.8	1.8	65.9	135.4
Exotic Marsh	6.1	36.2	42.3	102.2	291.0*
Freshwater Marsh	12.6	2.6	15.2	70.3	171.0
Permanent Pond	0	0	0	84.7	84.7

* Mitigated as Freshwater Marsh

Table 5-17. Jurisdictional Wetlands Remaining on Habitat Islands and Additional Mitigation Requirement

Habitat Type	Bouldin Island (acres)	Holland Tract (acres)	Total Remaining (acres)	Potential Mitigation (acres)	Total Required in New HMP (acres)
Cottonwood Willow Woodland	2.0	75.0	77.0	301.2	378.2
Great Valley Willow Scrub	7.5	6.0	13.5	135.4	148.9
Exotic Marsh	32.2	24.3	56.5	0	56.5
Freshwater Marsh	57.9	56.4	114.3	462.0	576.3
Permanent Pond	1.0	9.8	10.8	84.7	95.5

Revised Habitat Management Plan

Because some of the jurisdictional wetland habitat types are consistent with GGS habitat, the revised HMP can be designed to accommodate the mitigation requirements for both. Table 5-18 depicts the minimum habitat types and acreages required to mitigate impacts to potential GGS habitat and jurisdictional wetlands. Additional habitat types are included to mitigate for the impacts to the greater sandhill crane and Swainson's hawk. DWR would have to acquire conservation easements offsite to fully mitigate for the impacts to Swainson's hawks.

Table 5-18. Revised HMP Mitigation Strategy

Habitat Type	Bouldin Island (acres)	Holland Tract (acres)	Total (acres)
Suitable Upland GGS Habitat	***1396.0***	***834.0***	***2230.0***
Cottonwood Willow Woodland	190.6	187.6	378.2
Great Valley Willow Scrub	92.3	56.6	148.9
Herbaceous Upland	947.7	540.7	1488.4
Canal (Upland Component)	165.4	49.1	214.5
Suitable Aquatic GGS Habitat	***698.0***	***417.0***	***1115.0***
Emergent Marsh	543.3	378.0	921.3
Permanent Pond	85.7	9.8	95.5
Canal (Aquatic Component)	69.0	29.2	98.2
Total Suitable GGS Habitat	***2094.0***	***1251.0***	***3345.0***
Unsuitable Habitat for GGS	***3932.0***	***1840.0***	***5772.0***
Other crops(harvested)	350.0	170.0	520.0
Corn (unharvested)	339.2	105.7	444.9
Wheat (unharvested)	1225.0	595.0	1820.0
Alfalfa	1925.0	935.0	2860.0
Developed	92.8	34.3	127.1

Greater Sandhill Crane Mitigation

DFG has not established specific requirements or guidelines for assessing or mitigating impacts on the greater sandhill crane. DWR proposes to mitigate impacts of the In-Delta Storage Project on wintering greater sandhill cranes by providing diverse habitat assemblages. Habitat components would fulfill the survival needs of wintering cranes and provide calories to store for spring migration. Essential habitats that DWR would provide include:

- Corn and wheat crops for acquiring sufficient carbohydrates,
- Grasslands and alfalfa for obtaining protein, calcium, and other essential nutrients, and
- Seasonal wetlands (flooded agricultural and fallow fields) for protected roosting and loafing sites and for obtaining protein.

A total of 10,647 acres of mostly harvested crops and roosting habitat would be lost from flooding the reservoir islands and from developing unsuitable crane habitat types on the habitat islands. Under the revised HMP, about 6,613 acres of foraging and roosting habitat would be developed on Bouldin Island and Holland Tract (Table 5-19). DWR would purchase conservation easement of approximately 3,900 acres for Swainson's hawk mitigation, which may convert corn to harvested alfalfa and wheat. Approximately 900,000 pounds of corn would be available for forage, which is about 400,000 less than the amount that would be lost (1,280,123.) on the project islands. There would be approximately 4.5 million pounds of wheat available for forage, which is more than 21 times the amount of wheat that would be lost (209,976). Overall there would be over 5.4 million pounds of grain available for forage, which is over three times the amount of grain that would be lost on the project islands. If all 3,900 acres of the conservation easements acquired for Swainson's hawks would result in corn being converted to alfalfa, wheat and other crops; about 600,000 pounds of grains available for forage would be lost on adjacent islands.

Table 5-19. Revised HMP Habitats Suitable for Greater Sandhill Crane

Habitat Type	Bouldin Island (acres)	Holland Tract (acres)	Total (acres)	Pounds of Forage
Corn (unharvested)	339.2	105.7	444.9	889,800
Wheat (unharvested)	1225.0	595.0	1820.0	4,550,000*
Herbaceous Upland	947.7	540.7	1488.4	
Alfalfa	1925.0	935.0	1894.9	
Suitable greater sandhill crane habitat	***3436.9***	***2176.4***	***5613.3***	***5,439,800***

* This estimate assumes that up to half the wheatfields will be flooded for roosting/loafing habitat

Greater Sandhill Crane Habitats

The habitat design and management recommendations provided below are based upon the recommendations provided by Littlefield and Ivey (2000) for the Cosumnes River Floodplain and the Delta regions of California.

Seasonal Wetlands (flooded agriculture and fallow fields)

Seasonal Wetlands should be managed at an early seral vegetation stage, with flooding during the wet season (November through April). Some wetlands (roost sites), however, should be flooded by early September for cranes that arrive in early fall. Dense stands of emergent vegetation or other heavy cover should be removed, as cranes tend to avoid these wetlands. Seasonal wetland design and management should include the following:

- Seasonal wetlands should be widely dispersed and be maintained with flowing water to reduce potential for disease outbreaks.
- Wetlands should be designed with sloping banks which allow cranes to walk onto the site from adjacent uplands

- Seasonal wetlands should be at least 8 ha (20 acres) in size; wetlands 40 ha (100 acres) or more is preferred to provide additional security and benefit to cranes and to a variety of other wetland species
- Water levels should be managed to provide extensive areas at depths ranging from 8-20 cm (3-8 inches).
- A portion of the seasonal wetlands should be in a seasonal wetlands-to-agriculture rotation. After two years the seasonal wetlands is planted in wheat for four years. Seasonal wetlands provide habitat to additional wildlife species and are preferred by cranes. Also, the vegetation grown in the wetlands over two years may reduce the loss of organic soils from oxidation. The percentage of this habitat will be determined during consultation with regulatory agencies.
- Small gravels should be spread along roads, bare shoreline areas or on islands to provide grit sources for cranes
- Seasonal wetlands should be positioned at least 0.1 km (0.25 mile) from heavy traffic; areas open to hunting, or other disturbing uses. If hunting occurs in roost sites, than it should be limited to mornings before 10 am, before cranes return to wetlands for loafing.

Corn and Wheat Fields

- Corn and wheat fields should be managed to provide an abundance of food that persists through the winter period. Unharvested grain fields should be a minimum of 8-12 ha (20 - 30 acres).
- A percentage of the unharvested cornfields should be left standing into March. The percentage of the corn to be left standing will be determined during consultation with the regulatory agencies.
- Winter wheat can provide multiple benefits to cranes. Flooding harvested fields for preirrigation of the next crop in September provides wetland roost areas, and wheat fields planted in succession in late fall and early winter provide a sustained source of grain and new green sprouts for cranes foraging through most of the winter period.

Herbaceous Upland

- Herbaceous uplands should be managed to provide vegetation that does not exceed 25 cm (10 inches).
- Sides of levees should be managed for short vegetation. Cranes frequently feed and loaf on levees during the daytime.

- ∉ Graze 20 -40 % of grasslands with cattle or burn in the autumn to provide green plant foods for crane foraging, if compatible with other sensitive species.

Other Mitigation Options for Greater Sandhill Crane

If all greater sandhill crane mitigation requirements can not be physically located on Bouldin Island and Holland Tract, then DWR should explore the possibility of providing funds to improve or develop crane roosting habitats on Staten Island.

Swainson's Hawk Mitigation

Effects of added Giant Garter Snake Mitigation Habitat on available Swainson's Hawk Habitat

If giant garter snakes are determined to occur on the reservoir islands at the maximum potential identified by Hansen and Patterson, and the amount GGS/wetland habitat on Bouldin Island is increased to approximately 2100 acres (as per revised HMP developed by DWR), acreage for upland crops will be reduced to approximately 3800 acres. Corn for cranes will be planted on 300 acres, and 3500 acres will be available for an high value Swainson's hawk crop mix (alfalfa and wheat in rotation with other suitable crops/fallowed fields at a recommended 55-35-10 division, respectively). The target Swainson's hawk forage value for Bouldin Island is about 18,900. If all 3500 acres of remaining cropland were grown in the high value mix, Bouldin's total foraging value would be 14,000. An additional 1650 acres of value 1 cropland would have to be purchased and grown to the high value mix to fully mitigate the loss of Swainson's hawk foraging habitat on both Webb Tract and Bouldin Island.

Up to 1250 acres of GGS/wetland habitat will be added to Holland Tract to account for the loss of GGS habitat and wetlands on Bacon Island, as per revised HMP. This and the 100 acres of crane feed plots will reduce available Swainson's hawk foraging habitat on Holland Tract to 1700 acres. The target Swainson's hawk forage value for Holland Tract is about 13,600. If all available crop acres are grown in high value Swainson's hawk mix, Holland Tract would reach a forage value of 6800, requiring that an additional 2250 acres of value 1 cropland would have to be purchased and managed in the high value foraging habitat mix. All totaled, DWR would have to purchase an additional 3900 acres of value 1 cropland and convert the crop to the high value mix.

Integrating the 1995 HMP with Swainson's hawk mitigation needs

The ratio of habitat types developed for the two habitat islands in the 1995 Delta Wetlands Habitat Management Plan would further reduce the available Swainson's hawk foraging area on both Bouldin Island and Holland Tract. The HMP ratios would result in a maximum of just 2881 acres and 1810 acres, respectively, or just 25% of the original Swainson's hawk foraging habitat that (currently) exists on the project islands.

Given that DWR would have to purchase an additional 3500 acres of upland crop habitat to offset impacts to Swainson's hawks and giant garter snakes, it is likely that all non-crop habitat types listed in the HMP may be maintained in gross acreage. In addition, it is likely that the combination of wheat and alfalfa, managed appropriately for Swainson's hawks during their nesting period, could be managed appropriately for waterfowl, sandhill cranes, and other wildlife species during winter periods. So although the HMP in its current form (specific land uses and ratios) would not be compatible with mitigation ratios needed to sustain Swainson's hawks at current level on project islands, it would only need minor modifications to meet the listed species needs and the original goals of the document.

Integrating Swainson's Hawk Mitigation with Sandhill Crane Mitigation

The revised HMP ratios developed for GGS and Sandhill Crane (SACR) indicate that GGS habitats will account for about 2100 acres on Bouldin and 1250 acres on Holland. Since these habitats have little or no forage value for Swainson's hawks, about 3800 and 1800 acres of cropland exists to be managed for SWHAs and SACR on Bouldin and Holland, respectively.

The recommended crop ratios to mitigate lost Swainson's hawk habitat on the remaining cropland is 60% alfalfa and 40% wheat, with 10% of all cropland rotated to other usable crops/vegetation to keep soils healthy. According to information provided by Gary Ivey, sandhill cranes prefer wheat to other grains, so sandhill crane habitat and Swainson's hawk habitat are almost completely compatible with specific management regimes; those include leaving wheat unharvested and rotating some agricultural lands into “seasonal wetlands” by flooding fallowed fields. The loss of potential roost sites on Webb and Bacon will be mitigated by the wetted fallowed fields and by shallow-flooding other cropland in appropriate amounts.

Ivey also recommends small feed-plots of unharvested corn approximately 30 acres in size. Such feed plots totaling 150 acres can support thousands of cranes with necessary carbohydrates for migration; that would more than cover the current use by cranes on the islands. Each island should include six- 30 acre feed plots in close proximity to fields designated for roosting. This would reduce Swainson’s hawk-compatible forage crops to approximately 3500 and 1700 acres on Bouldin and Holland, respectively.

If the remaining 3500 acres of available cropland on Bouldin are grown to alfalfa and wheat at the above ratio with a 10% yearly rotation of those crops to other Swainson’s hawk-usable crops and flooded fallowed fields, about 1650 offsite acres would have to be obtained under easement to provide essentially the same forage value that Bouldin and Webb have at baseline. A percentage of the unharvested wheat should be "knocked down" to create an edge effect to increase accessibility to prey for Swainson's hawks

If the remaining 1700 acres of available cropland on Holland are grown to the recommended Swainson’s hawk-compatible crop ratio, an additional 2250 acres would have to be obtained offsite through conservation easement to achieve a similar forage value contained by both Holland and Bacon at baseline. The amount of offsite habitat obtained by easement for both reservoir islands would be reduced should the amount of wetland mitigation be reduced, and additional cropland on the habitat islands became available for cranes and Swainson’s hawks.

Sandhill Crane Needs

Information provided by Gary Ivey in a personal communication and in a report on conservation for sandhill cranes indicates that almost all habitat provided for Swainson’s hawk mitigation for the project can be managed for crane habitat as well. Wheat is the crane’s preferred grain forage, and alfalfa is forage habitat for high protein invertebrates. Roost sites can be provided by flooding cropland and fallowed fields, and would be equivalent to those lost on the reservoir islands. Plots of unharvested corn will provide late season forage for cranes. Refer to the greater sandhill crane section for information on habitat needs.

Other Mitigation Options Considered

During the public review of the 2002 Draft In-Delta Storage Program Environmental Evaluations Report DWR was requested to evaluate the possibility of mitigating for wildlife impacts on Sherman Island and Twitchell Island and leaving Bouldin Island in agriculture. The CALFED ROD has committed to restoring habitats on Sherman Island and Twitchell Island through the Ecosystem Restoration Program (ERP). The ERP has committed to restoring nontidal perennial aquatic habitat, freshwater emergent wetland habitat (nontidal), and seasonal wetland habitat on Sherman Island and Twitchell Island (CALFED 2000). Since, the ROD for the CALFED program has been authorized, ERP action on Sherman Island and Twitchell Island would have priority over In-Delta Storage Project future actions.

DWR and Reclamation also investigated the feasibility of mitigating for all giant garter snake habitat (if ongoing surveys establish their presence) and jurisdictional wetlands impacts on the reservoir islands through off site mitigation. The study concluded that no mitigation banks are currently available to service the entirety of Project impacts to the giant garter snake and jurisdictional wetlands. Based on current market values in the Sacramento Valley region, the cost per giant garter snake credit is $25,000 per acre, and the cost of riparian woodland is $60,000 per acre. The Sacramento District Corps will allow mitigation for emergent wetland and permanent pond to be counted toward meeting the aquatic habitat component of the giant garter snake mitigation as long as both the species needs and wetland requirements are met. Under a worst-case scenario, Project mitigation costs for jurisdictional wetlands and the giant garter snake are approximately $109 Million. Given the magnitude of compensatory habitat required to meet giant garter snake and jurisdictional wetland mitigation requirements, development of a mitigation bank specifically for the In-Delta Storage Project, or exploring mitigation options on suitable properties already owned by the Department or U.S. Bureau of Reclamation may be warranted.

The complete technical memorandum of the investigation regarding off site mitigation is included in Appendix D.

Weed Management

Invasive, non-native plants are a problem for farmers and can have a negative impact on native habitats. In many cases, once a weedy species invades a natural habitat, that native plant community is lost or severely degraded, and any wildlife relying on certain plants as integral components of that community can also become displaced (Williams 1997; Randall et al. 1998).

According to the DFA, a noxious weed is a plant that is defined as a pest by law or regulation. Pest plants are given a rating (A, B, C, D or Q) based on the importance of the pest, the ability to eradicate or control the plant successfully, and the present distribution within the state (DFA 2002).

Definitions for state ratings:

∉ "A" is an organism of known economic importance subject to state enforced action involving: eradication, quarantine, containment, rejection, or other holding action.

∉ "B" is an organism of known economic importance subject to: eradication, containment, control, or other holding action at the discretion of the individual county agricultural commissioner.

∉ "C" is an organism subject to no state enforced action outside of nurseries except to retard spread. At the discretion of the commissioner.

∉ "D" Requires no action (Parasites, predators, and organisms of little or no economic importance).

∉ "Q" is an organism or disorder requiring temporary "A" action pending determination of a permanent rating.

The California Exotic Pest Plant Council (CalEPPC) also maintains a list of pest plants of greatest ecological concern in California. This list focuses on non-native plants that are a serious problem in California's wild lands. The list is broken up into most invasive plants (List A), plants of lesser invasiveness (List B), and pest plants with potential to spread explosively (Red Alert) (Anderson, DiTomaso and others 1999).

The most commonly encountered invasive species found in this part of the Delta and listed by either CDFA or CalEPPC are shown in Table 5-20. Weed control efforts on the habitat and reservoir islands will be directed toward, but will not be exclusive to, these plants.

Table 5-20. Invasive terrestrial plant species known to occur in or near the project area.

Common name	Scientific name	Known on Project islands	CDFA status	CalEPPC List
Russian knapweed	*Acroptilon repens*	x	B	
Tree of heaven	*Ailanthus altissima*	x		A-2
Giant reed*	*Arundo donax*	x		A-1
Black mustard	*Brassica nigra*	x		B
Red brome	*Bromus madritensis* ssp. *rubens*	x		A-2
Italian thistle	*Carduus pycnocephalus*	x		B
Yellow star thistle	*Centaurea solstitialis*	x	C	A-1
Bull thistle	*Cirsium vulgare*	x		B
Poison hemlock	*Conium maculatum*	x		B
Pampas grass	*Cortaderia selloana*	x		A-1
Cape ivy	*Delairea odorata*			A-1
Brazilian waterweed	*Egeria densa*	x		A-2
Water hyacinth	*Eichhornia crassipes*	x		A-2
Blue gum	*Eucalyptus globulus*	x		A-1
Edible fig	*Ficus carica*	x		A-2
Fennel	*Foeniculum vulgare*	x		A-1
Hydrilla	*Hydrilla verticillata*		A	
Velvet grass	*Holcus lanatus*	x		B
Yellow water iris	*Iris pseudacorus*	x		B
Perennial pepperweed	*Lepidium latifolium*	x	B	A-1
Purple loosestrife	*Lythrum salicaria*		B	
Parrot's feather	*Myriophyllum aquaticum*	x		B
Eurasian water-milfoil	*Myriophyllum spicatum*	x		A-1
Crispate-leaved pondweed	*Potamogeton crispus*	x		B
Himalayan blackberry	*Rubus discolor*	x		A-2
Silverleaf nightshade	*Solanum elaeagnifolium*	x	B	
Medusa-head	*Taeniatherum caput-medusae*	x	C	A-1
Tamarisk	*Tamarisk spp.*	x		A-1

Management measures

The weed management program will use an adaptive management approach, as outlined by Hoshovsky and Randall (2000). The adaptive management approach includes:

∉ Establish management goals and objectives for each site.

∉ Determine which weed species may hinder the attainment of the goals.

∉ Determine which methods are available for control of the species.

∉ Design and implement a management plan designed to move conditions towards management goals and objectives.

- Monitor and assess the impacts of management actions in terms of effectiveness in moving towards goals and objectives.
- Reevaluate, modify if necessary, and start the cycle again.

The goals and objectives of habitat management will be specific to each island, but control of weed populations will depend on three main strategies:

1. Prevention and early detection of new infestations
2. Physical and chemical control measures
3. Biological control measures

Preventing new infestation

Prevention of a weed infestation is the most effective method of control. This strategy must incorporate education about the weed, how it spreads and its impact to the area. It is necessary for workers to understand the appropriate weed abatement measures and cleanup for different weed species (some plants can propagate from a root cutting or just a small piece of the plant). All agencies and personnel working on the islands must be aware of the weeds of concern and the procedures used to prevent infestations.

Some of the main precautionary measures that can be taken to prevent weed infestation or spreading of a new infestation include: removing seed sources from roads, trails and other dispersal routes; planning construction projects to minimize soil disturbance and reestablish vegetation as soon as possible; making sure that fill dirt, mulch, seed mixes or other materials imported to the site are weed-free; washing vehicles and equipment to remove weed seeds and other propagules before moving them to another area; and follow-up monitoring of work sites to detect new weed populations while they are still small and easily controlled (Hoshovsky and Randall 2000).

Early detection of new infestations

Early detection of new infestations of weeds is an important tool. If detected early enough, a weedy species can be eradicated before it spreads and becomes a larger problem. With early detection some simple methods such as manually pulling or mowing can be used for eradication, versus repeated use of herbicide treatments, which is a more expensive weed abatement method. Periodic monitoring of the islands by a qualified botanist will aid in detecting new weed infestations.

Physical and chemical control measures

There are several measures that may be used to control weeds; effectiveness of each method should be evaluated on a species level and site-specifically.

Hand pulling/ hand weeding: Hand weeding is a good method when dealing with small infestations of plants or infestations that occur in sensitive habitat areas. This method is best used on plants with a tap root (knapweed, pepperweed) and some young plants. One downside of this method is that it is very time consuming and can be costly.

Pros: Non-toxic, selective process suitable for native habitat areas.

Cons: Time consuming, costly and labor intensive; can result in bare ground where other non-natives can invade; possible trampling of non-target species.

Mowing and disking: Mowing or disking work well to reduce weed populations when done at the right time of the year (before seed production). These methods can be used in conjunction with other methods like herbicides or burning.

Pros: Non-toxic, reduces seed production. Disking is cost effective and most appropriate when used in agricultural settings.

Cons: Mowing doesn't kill weeds, it just suppresses them; both methods are non-specific; soil disturbance can open up sites to other weed infestations.

Burning or Flaming. Prescribed burns can be effective in reducing weeds, especially in native plant communities that evolved with fire. This method may help in the suppression of yellow star thistle by burning before the plant produces viable seed (June-July). Flaming selected weeds and heat-girdling stems of brushy species using a blowtorch or flamethrower is less costly than selective herbicide treatment and is effective in wet weather.

Pros: Can improve efficiency of herbicide treatment by removing old plant materials and litter, allowing more herbicide to reach the living tissues of the weeds.

Cons: Causes air pollution; hard to get fire hot enough to kill seeds; some natives are not fire-tolerant; burn permits can be difficult to obtain; fire escape is a risk; erosion can be a problem on denuded soils.

Flooding. Flooding can be an effective method of weed control. Many plant species cannot withstand periods of prolonged flooding (*Lepidium*). This method works by preventing oxygen from getting to the roots of the plant.

Pros: Non-toxic, cheap method if water is available.

Cons: Does not impact weed seeds; some seeds can remain viable for 2 years after flooding. Flooding may spread weed seeds and plant parts further into an area.

Herbicides. Herbicides should only be applied by a licensed pesticide applicator. Spot treatment with herbicides is preferable over broadcast spraying. When herbicides are used, signs should be placed in areas to notify visitors and personnel of the potential harm and should state when re-entry to those areas is allowed.

Pros: Can cover a larger area of weed infestation; maintain a longer time period in between treatments; causes minimal ground disturbance.

Cons: Toxic; requires a trained and qualified applicator and reporting of use; may impact non-target plant species; some chemicals cannot be used in or near water; chemicals may persist and contaminate the environment; can be expensive.

Biological control measures

Biological control involves the use of animals, fungi or other microbes that prey upon, consume, or parasitize a target species (Bossard and others 2000). At this time, no specific biocontrol agents have been identified for most of the weed species of concern in the project area, except for purple loosestrife. There are two leaf-eating beetles (*Galerucella spp*.), a root-mining weevil (*Hylobuius transversovittatus*), and a seed-eating beetle (*Nanophyes marmoratus*) permitted for release in California to control loosestrife; however low loosestrife density in the Delta may not be able to sustain insect populations (SFEI 2003).

Managed grazing. Grazing by cattle, goats, or sheep can be an important tool in weed management. Intensive grazing can be timed to coincide with a particular stage in the weed life cycle that is most vulnerable to predation.

Pros: If properly managed, grazing is minimally disruptive to native habitats, and does not require a large investment of time or funding.

Cons: Grazing must be continued until the weed's seedbank is exhausted. Some weeds may be spread by the droppings of grazing animals.

Competition and restoration. Restoration of native habitats by seeding and/or planting natives provides competition for the weeds. Seed or other propagules should be collected from on site or nearby to increase chances of successful restoration.

Pros: Increases habitat values and provides a long-term solution to weed problems.

Cons: Expensive method, requiring lots of input and management especially in the first few years. Potential introduction of poorly adapted genotypes or loss of genetic diversity if propagules are not available locally.

Weed species of concern and potential control measures

Of the 28 weed species listed in Table X-1, only 6 represent a substantial threat to native terrestrial plant communities of concern on the project islands (marshes and other wetlands, riparian areas). These are giant reed, pampas grass, cape ivy, perennial pepperweed, purple loosestrife, and Himalayan blackberry. Other species are primarily invaders of disturbed sites and can be managed using standard agricultural weed control measures. Aquatic weeds such as Brazilian waterweed and water hyacinth are a management concern in ponds, ditches, and canals on the habitat islands and on the reservoir islands; waterways adjacent to the islands fall under the management of the Department of Boating and Waterways, which maintains control programs for these species.

Giant reed (*Arundo donax*)

Giant reed is the largest member of the grass family (Poaceae). It is a perennial plant that reaches from 9 to 30 feet tall, often growing in clumps reaching hundreds of feet across. Leaves are in 2 rows along the stem, and the hollow stems are about 1-½ inches in diameter. A large flower head (panicle) extends 1 to 2 feet from the top of the stem (Hickman 1993); however, the species has not been observed to set viable seed in California. This plant primarily reproduces by rhizomes but pieces of the stem may also regenerate. Plants have been observed to grow 4 inches per day, one of the fastest rates known for terrestrial plants.

Because of its aggressive growth, *Arundo* can choke out other native plants and may actually block stream channels and cause flooding and erosion. It is also a fire hazard, since the tall stems become brittle and burn quickly. While fire will burn the aboveground parts of the plant, the underground matted roots (rhizomes) survive fire and regenerate quickly (Dudley 2002).

Possible Control Methods

Plants that are less than 6 feet tall can be removed by hand. Since this plant can regenerate from small pieces of stem or root material, the entire plant should be removed from the site and disposed of properly. This method allows for selective removal and very little disturbance to surrounding vegetation (Dudley 2000).

Larger plants are trimmed back to the base, then treated with the proper herbicide (one containing glyphosate as the active ingredient). The herbicide can be painted directly onto the remaining portions of the plant. This procedure may need to be repeated until the plant dies.

Rodeo® and Roundup® (both have glyphosate as the active ingredient) are registered for use in California on *Arundo*. Rodeo® can be used in wetlands; Roundup® can only be used away from water in the upland areas. Herbicide is most effective when applied to plants after flowering and before they go dormant, usually from August to early November (Dudley 2000).

For control of plants in wetlands, a 50- 75% solution of Rodeo® can be applied to stems cut within 2 to 4 inches of the substrate. The concentrate can be applied with a sponge, and it may be advantageous to add a dye to the concentrate so it can be seen. Follow-up of this method should occur once a month over a period of 6 months (Dudley 2000).

Water hyacinth (*Eichhornia crassipes*)

Water hyacinth is a generally free-floating perennial member of the Pontederiaceae (Pickerel-weed) family. The leaves are bright green and waxy and the flower is lilac, pale blue or white with yellow stripes on the petals. Plants can multiply and spread vegetatively, by the roots, and by seeds, which can remain viable for up to 20 years (Batcher 2001). This plant forms dense mats on the water surface. It can be found in natural and man-made fresh water systems.

Plants can quickly dominate a waterway, degrading habitat for waterfowl, impeding drainage, obstructing navigation, fouling water pumps and blocking irrigation channels (Godfrey 2000). Reduction in water flow can cause flooding which can damage canal and levee banks; areas with decreased flows can also be ideal breeding sites for mosquitoes and other vectors (Godfrey 2000; Batcher 2001).

Possible Control Methods

Small infestations can be harvested, removed and left to dry on the banks. With this method all plant material needs to be removed or it will re-infest the area (Godfrey 2000). This method is labor-intensive and expensive. Floating barriers can be placed in an area to contain the weeds and then they can de dredged out and left to die on the banks.

Chemical sprays have been used, but all products need to be registered for use in the aquatic environment. The California Department of Pesticide Regulations retains a list of those products registered for use in California for different ecosystems. Directions on the product label should always be followed when applying a pesticide. Glyphosate (Rodeo ®) has been used as a foliar spray, and an application of 2 kg/ha kills the plants (Godfrey 2000; Batcher 2001). This active ingredient is non-toxic to fish, but slightly toxic to aquatic invertebrates. Copper sulfate has also been used as a spray.

Perennial pepperweed (*Lepidium latifolium*)

Perennial pepperweed is a member of the mustard family (Brassicaceae) that can grow over 6 feet high, (typically 3 to 4 feet), with smooth, green-grayish leaves, dense aggregations of tiny (< 1/4 in.) white flowers, and horizontal underground stems (rhizome) that can be viewed by uprooting a plant. The species is native to Eurasia, and arrived on the East Coast of the United States about 1924. By 1941 the plant was present in Solano County, and in subsequent years has spread to large areas of the South Delta, and to limited areas of the Central Bay (May 1995).

Perennial pepperweed spreads through dispersal of seeds and rhizome fragments, and can establish dense colonies in a variety of environments including marshes, meadows, saline soils, riparian areas, beaches, and disturbed areas such as roadsides, agricultural fields and irrigation channels. These dense colonies displace native plant species and dense linear patches along sloughs and levees can exclude all other vegetation.

Possible control methods

Chemical control appears to be the most effective means of controlling perennial pepperweed. Mechanical methods such as disking do not alone provide control because plants can rapidly resprout from fragments left in soil (Young et al. 1995). Prescribed burning is not an effective method of control alone, because typical infestations may not be able to maintain burning (Howald 2000). Flooding may be effective if an area can be flooded for a prolonged period of time (May 1995). Biological control agents are not available at this time, and are unlikely to be developed to associated risks posed to commercial crop plants in the mustard family (Brassicaceae) and native Lepidium species (Young et al. 1995).

Application of the herbicides chlorsulfuron, triclopyr (as Garlon3A® and Garlon4®), and glyphosate (as Rodeo® and Roundup®) have been shown to be effective in controlling perennial pepperweed in studies at Grizzly Island Wildlife Area in Suisun Marsh (Howald 2000). Estimated costs for materials and application by a contractor are estimated at approximately $250 per acre for glyphosate, depending on size of treatment area, scale of treatment, and herbicide dosage (Gibbons et al. 1999).

Cape ivy (*Delairea odorata = Senecio mikanioides*)

Cape ivy, a native of South Africa in the Asteraceae family, is a climbing vine with small inconspicuous yellow flowers, leaves and stems smooth, shiny, hairless, plentiful, bright green; leaves 1 to 4 in. long, evenly spaced on stem, with 5 to 9 lobes each. Cape ivy is easily confused with native wild cucumber (*Marah fabaceus*), which has less shiny leaves, ribbed vs. smooth stems, many spiraling tendrils and distinctive round 1 in. diameter fruits that are covered in spines. It was introduced to California in the 1950's as an ornamental and has spread to many coastal regions in the state (Bossard 2000).

Cape ivy grows well in shady and damp places and on disturbed ground. Cape ivy spreads by sending out runners that root and create new plants; fragments of runners or roots can resprout and establish new plants as well. Fragments of stolons were found to root after 10 weeks of drying in the sun. It is highly invasive, spreads quickly, and is capable of blanketing and smothering native vegetation, including trees (Bossard 2000).

Possible control methods

Manual or mechanical removal of stems and roots, using pointed or pronged rakes, is an effective control method when followed by removal of plant material to prevent resprouting of plant fragments. Follow-up monitoring and treatment, to remove resprouts, is required for effective control. This method involves a high likelihood of disturbance to non-target plant species because Cape ivy tends to grow in dense mats close to the ground (Bossard 2000).

Herbicide has been used effectively to control Cape ivy, as a mixture of 0.5% glyphosate, 0.5% triclopyr, and 0.1% silicone surfactant applied as a foliar spray. The optimal time for application is in late spring, after the flowering stage has ended (Bossard and Benefield 1995). Costs for materials and application by a contractor are approximately $250 per acre for glyphosate, depending on size of treatment area, scale of treatment, and dosage (Gibbons *et al*. 1999).

Prescribed burning has not been extensively studied as a control method because the foliage has a high moisture content. No biological control agents are currently available for release in California (Bossard 2000), but tests on potential control agents are underway by the USDA Agricultural Research Service (USDA-ARS) (Balciunas 2003).

Pampas grass (*Cortaderia jubata*)

Pampas grass is a large, dioecious tussock grass that is native to the Andes Mountains of northern Argentina, Bolivia, Peru, and Ecuador at elevations of 2800 to 3400 m, where it can form nearly solid stands of several hundred hectares (Costas Lippmann 1977). Pampas grass can be recognized by its distinctive huge nodding pinkish or purplish flower plumes (later turning creamy white), and dark green 1-cm-wide drooping leaves with razor-like margins. Flower stems often rise up to 3 times higher than the clump of foliage. Pampas grass flourishes mostly in coastal areas and probably needs at least some summer moisture from fogs and freedom from freezing temperatures. Several consecutive nights of frost will generally not kill the plant, but can severely damage it (Costas Lippmann 1977).

The chief reason for the success of pampas grass as an invader is its prolific production of seeds, which are abundantly produced annually, and which rapidly establish on bare soil. Seeds establish most readily in wet sandy soil without existing vegetation, but have broad habitat requirements and will grow vigorously in nearly any soil, under low or high moisture regimes, in full sun or dense shade (Cowan 1976). Pampas grass seedlings rapidly grow and accumulate above- and belowground biomass once they are established, making them highly competitive with native plants. Even at low densities pampas grass can out compete other species because of the amount of cover it can occupy; even a few plants can have a large potential impact because it is a perennial plant, produces seed annually, and the seeds are light and wind-dispersed.

Possible control methods

Every effort to control pampas grass should be made before it becomes well established. Adequate control of pampas grass can be achieved with mechanical or chemical methods or both. Physical removal is effective, and minimizes impact on the native plant community, if there are low densities of the weed or if the individual plants are quite small. Seedlings or small plants can be pulled or dug out, and large plants can be dug out with a pick and shovel. The entire root crown must be removed to avoid subsequent sprouting, although it is not necessary to dig up all the lateral roots (Cowan 1976). Plumes should be cut off plants that cannot be removed immediately to reduce dispersal of seeds.

In areas with high plant densities or with well-established plants, pampas grass is best controlled with chemical treatments. Aminotriazol and dalapon have been used to control pampas grass (Anonymous 1976), although no guidelines are available on concentrations. Roundup can be used successfully to kill both seedlings and large plants of pampas grass (DiTomaso 2000), where it should be sprayed on the plants early in the morning at concentrations recommended by the manufacturer, taking care to avoid spraying it on nontarget plants. Even if herbicides are successful in killing the plant, a large amount of dead biomass remains on the surface to prevent access by native vegetation.

Purple loosestrife (*Lythrum salicaria*)

Purple loosestrife is an erect perennial with showy pinkish-purple flower spikes that is native to Eurasia. Mature plants can grow 2 - 3 m tall, and develop into a large clump up to 1.5 m in diameter. Above ground foliage usually dies during the cool season, and new shoots sprout from a broad woody crown in spring. Originally cultivated as an ornamental and medicinal herb, purple loosestrife has escaped cultivation and become a noxious weed of wetlands in many regions throughout temperate North America, often forming dense colonies that displace native vegetation and wildlife (Benefield 2000).

Plants reproduce primarily by seed, although stem fragments can develop roots under favorable conditions. A large plant can produce more than 2 million viable seeds in one season, which disperse with water, mud, human activities, and by clinging to feathers, fur, and feet of animals. Seeds typically germinate mid-spring through early summer, producing seedlings that can mature and flower within 8-10 weeks.

Possible control methods

Mechanical control is effective mainly for small infestations, and includes mowing or cutting, pulling, and digging. While mowing is generally ineffective, mowing timed at the bud stage may reduce seed production. Timing is critical, because mowing at earlier stages may increase stem densities, and mowing after seed production only serves to spread the infestation. Mowing is frequently not even an option in most wetland areas, drainages, or along watercourses. Hand pulling or digging results in more disturbance, but may be successful on small infestations. Young plants are easily pulled, but older plants may require extensive digging. New plants may emerge from missed roots or from stems left lying in contact with moist soil.

Biological control is probably the most viable option for long-term control of large purple loosestrife infestations. At least four insects are being tested in California, but none are currently available for release. Two species of leaf-eating beetles (black-margined and golden loosestrife beetles) have had considerable success in reducing purple loosestrife in other states and may be promising here in California.

Chemical control can be used effectively on large infestations. Spot applications of glyphosate at 1.5% v/v timed at the early flowering stage have been effective, and fall applications are recommended. Glyphosate can be successfully integrated with mowing and applied directly to the tops of cut stems in a 20-30% solution with a wick applicator. It is important when using herbicide to avoid injury to desirable vegetation because purple loosestrife is highly competitive and will rapidly reinfest open areas. It may not be necessary to wet all of the foliage completely to kill the plant, but wetting at least 25% of the foliage is recommended.

Himalayan blackberry (*Rubus discolor*)

Himalayan blackberry, a plant in the rose family (Rosaceae), grows as a dense thicket of long, bending branches (canes), appearing as tall, ten-foot mounds or banks, particularly along watercourses. Leaves have five leaflets, and canes have stout hooked prickles; in contrast, native blackberries have three leaflets and much thinner prickles. Flowers are white, yielding black berries that usually ripen later than native blackberries. Flowering begins in May and continues through July. Fruit is produced from July to September. Most blackberries produce good seed crops nearly every year. Immature fruit of Himalayan blackberry is red and hard, but at maturity fruit becomes shiny black, soft, and succulent.

Despite its name, Himalayan blackberry is native to western Europe (Hickman 1993). It was probably introduced to North America in 1885 as a cultivated crop and by 1945 it had become naturalized along the West Coast and also occurred in nursery and experimental grounds along the East Coast and in Ohio (Bailey 1945). Himalayan blackberry occurs in California along the coast in the Coast Ranges, Central Valley, and the Sierra Nevada (Dudley and Collins 1995), forming impenetrable thickets in wastelands, pastures, and forest plantations, roadsides, creek gullies, river flats, fence lines, and right-of-way corridors (Parsons and Amor 1968). It is common in riparian areas, where it establishes and persists despite periodic inundation by fresh or brackish water.

It seeds heavily, and seeds are readily dispersed by mammals and birds. Seeds can be spread considerable distances by streams and rivers (Parsons 1992). It also spreads vegetatively by rooting of cane tips. Periodic flooding can produce conditions conducive to the growth and spread of blackberries. Himalayan blackberry is one of few woody plants that pioneer certain intertidal zones of the lower Sacramento River (Katibah *et al*. 1984). Himalayan blackberry tolerates a wide range of soil pH and texture but does require adequate soil moisture, and seems to prefer disturbed and wet sites even in relatively wet climates.

Possible control methods

Mechanical removal or burning may be the most effective ways of removing mature plants. Most mechanical control techniques, such as cutting or using a weed wrench, are suitable for Himalayan blackberry. Care should be taken to prevent vegetative reproduction from cuttings. Burning slash piles is an effective method of disposal. Treatment with herbicides should be considered cautiously for two reasons: Himalayan blackberry often grows in riparian areas, where the herbicide may be distributed to unforeseen locations by running water, and some herbicides promote vegetative growth from lateral roots.

Reestablishment of Himalayan blackberry may be prevented by planting fast-growing shrubs or trees, since the species is usually intolerant of shade. Regrowth has also been controlled by grazing sheep and goats in areas where mature plants have been removed.

Brazilian waterweed (*Egeria densa*)

Brazilian waterweed (*Egeria densa*) is a perennial freshwater aquatic herb in the Hydrocharitaceae family, native to Argentina, Brazil, and Uruguay. It has stems up to fifteen feet long that are frequently branched, which are covered with whorls of small green leaves. It is distinguished from related species by the absence of turions (shoots from underground stems) and tubers and by the presence of showy, white flowers that float on or just above the water. It is usually rooted in bottom mud, but may be found as a free-floating mat or fragments with its buoyant stems near the surface. Brazilian waterweed occurs in cool to warm freshwater ponds, lakes, reservoirs, and slowly flowing streams and sloughs. It can root up to seven meters below the water surface (Parsons 1992). In California, Brazilian waterweed occurs at less than 7,000 feet elevation in the Sierra Nevada, Central Valley, San Francisco Bay, and San Jacinto Mountains (Hickman 1993).

The timing and location of Brazilian waterweed’s entry into California are unknown, but human dispersal via the aquarium trade is the most common means of dispersal (Parsons 1992). Once naturalized, Brazilian waterweed can spread along existing water courses into suitable new habitats without further human activity. Stem fragments at least two nodes long frequently break off and float away from the parent plant during active growth in spring (Parsons 1992). Fragments occur during all times of the year because of mechanical shearing of water flow, wave action, waterfowl activity, and boating.

Brazilian waterweed's dense growth significantly retards water flow, interfering with irrigation projects, hydroelectric utilities, and urban water supplies. It may also slow water traffic and interfere with recreational and commercial activities such as boating, swimming, and fishing. Brazilian waterweed reduces the abundance and diversity of native plants in lake bottoms, and this is probably accentuated by increased sediment accumulation beneath the weed beds (deWinton and Clayton 1996).

In California (and North America in general) reproduction and dispersal are via fragments of shoots and rhizomes, since only the male plant has become established. No seed formation has been documented (Anderson 1996, 1998). Stem fragments can take root in bottom mud or may remain as free-floating mats. Growth is most rapid during summer, as day length and temperature increase. Biomass in lakes reaches a maximum during late summer and fall. Thick mats form, consisting of long, intertwining, multi-branched stems below the water surface. No information is available on the rate of individual plant growth (Parsons 1992).

Possible control methods

Several methods are useful in removing Brazilian waterweed, particularly where water movement is minimal. Manual/mechanical methods such as pulling, cutting, and digging with machines are costly, provide only temporary relief, and encourage spread of the plant by fragmentation (mechanical harvesting produces thousands of viable fragments per acre (Anderson 1998). Biological control of Brazilian waterweed has been accomplished with introductions of two fish species into water bodies (Avault 1965): the white amur or Chinese grass carp (*Ctenopharyngodon idella*) and the Congo tilapia (*Tilapia melanopleura*). Currently, only the sterile (triploid) grass carp can be used in California and only in six southern California counties (Imperial, San Diego, Riverside, San Bernardino, Los Angeles, and Ventura). Permitted uses are authorized by the California Department of Fish and Game throughout the state with certain restrictions.

At present the following herbicides can be used at label concentrations to control Brazilian waterweed in California: diquat (contact type); copper-containing products (contact type); acrolein (contact type and highly restricted uses where no fisheries are impacted); and fluridone (systemic type requiring 4 to 6 weeks of treatment at very low rates) (Anderson 1996). However, herbicides in aquatic systems must be handled carefully to avoid worsening the situation - a specialist in control of aquatic weeds should be consulted before using.

Mitigation Cost Estimates

The preliminary cost estimates for the revised HMP are based on limited site information, limited planting specifications, and no engineering information (Table 5-21). Once the revised HMP is agreed upon by the resources agencies, engineering and construction requirements will be determined and more specific cost estimates for site construction, habitat development and operation and maintenance can be developed. Site construction and earthwork estimates are based upon the modified quantities provided by DW Properties. The unit cost was based upon the 2000 In-Delta Storage investigation Pre-Feasibility Study Draft Report (CALFED 2000b). The cost for conservation easements is based on the cost other agencies have paid for similar easements.

Table 5-21. Preliminary cost estimates for habitat development in the Revised HMP[a]

Activity	Estimated Cost
Purchase conservation easements (3,900 acres)	$ 4,680,000
Site construction (earthwork)[b]	$ 19,913,492
Vegetation installation[c]	$ 3,577,161
Subtotal	$ 23,490,653
Contingencies (20%)	$ 4,698,131
Contract subtotal	$ 28,188,784
Total Cost	$ 32,868,784

[a] Estimates are based on limited site information, limited planting specifications, and no engineering information.
[b] Site construction and earthwork estimates are based upon quantities provided by Delta Wetlands Properties. Unit cost was based upon the 2001 In-Delta Storage Program Draft Report on Engineering Investigations.
[c]Habitat vegetation cost estimates were based on the information in Table 5-21.
Note: Cost of borrow pond development, and pumps, siphons, & culverts associated with the habitat management plan are not included. Mitigation costs for levee improvements on the reservoir islands are not included. Land acquisition costs are not included.

Vegetation installation cost estimates were based on cost from similar projects in the region (i.e. Prospect Island, Decker Island, Stone Lakes, Cosumnes River Preserve, Hill Slough), current catalogs from plant nurseries, published information (EPA 1999) and adjusted for specific habitat development requirements (Tables 5-22 and 5-23). The cost estimates for developing crops were based upon UC Davis studies (Kearny and others 1994, 2000, Vargas et al 1998).

Table 5-22. Preliminary cost estimates for vegetation installation[a]

Develop Habitats	Total Acres	Estimated cost/acre	Estimated Cost
Corn	445	$ 69	$ 30,705
Wheat	1820	$ 25	$ 45,500
Alfalfa hay	2860	$ 87	$ 248,820
Other crops (harvested)[b]	540	$ 0	$ 0
Emergent marsh (min 30% cover after 3 years)	(276)921	$ 500	$ 138,000
Riparian (>350 seedling/acre after 3 years)	527	$ 5000	$ 2,635,000
Herbaceous upland (assume 25% native grass seed)	1488	$ 322	$ 479,136
Total			$ 3,577,161

[a] Estimates (adjusted for 2001 dollars) are based on costs from similar projects in the region (i.e. Prospect Island, Decker Island, Stone Lakes, Cosumnes River Preserve, Hill Slough), current catalogs from plant nurseries, EPA (1999), Kearny and others (1994 and 2000), Vargas et al (1998) and adjusted for the specific habitat development requirements.
[b] It is assumed that the income from selling these crops will cover the cost of installation and maintenance.

Table 5-23 provides an estimate of the on-going costs of mitigation and monitoring required for the project. Cost for the purchase and installation of pumps, siphons, and culverts were not included in this estimate. Annual average operations cost are based upon staff and equipment requirements for similar projects in the region. This includes costs for weed control. DWR staffing costs were used to determine these figures. This includes one full time habitat manager and 2 full time maintenance staff. The estimate does not include the cost of land acquisition or for the purchase of equipment. The monitoring plan development and implementation of the monitoring are based upon DWR staff time cost.

Table 5-23. Estimated ongoing costs for mitigation and monitoring for the revised Habitat Management Plan for the life of the project

Description	Unit	Cost (dollars)
Wildlife/habitat monitoring	Salary/year	121,500[a]
DFG monitoring support fund	Salary/year	80,000[b]
Airstrip operations monitoring	Salary/year	30,500[c]
Monitoring subtotal		202,000
Annual O&M cost for Habitat Islands	Salary & materials	1,000,000[d] - 1,400,000
Total ongoing annual cost		1,202,000 – 1,602,000

[a] DWR ES III salary (benefits & overhead) for 100% of the year (includes monitoring for listed and sensitive species, habitat requirements, 404 permit requirements, & conservation easements)
[b] Current August 2001 cost based on $75,000 per year, January 1998 dollars adjusted for inflation.
[c] DWR ES III salary (benefits & overhead) for 25% of the year
[d] Cost estimate includes salary for DWR Habitat Manager, 2 maintenance staff, and annual cost for habitat management.
Note: All costs are based on August 2001 dollars.

The preliminary cost estimates for implementing the habitat requirements in the revised HMP is approximately $33 million. This includes conservation easements for Swainson's hawks, earthwork, vegetation installation, contingencies and engineering, legal and administrative costs. Annual costs are estimated to be approximately $1.6 million. This includes implementing terrestrial monitoring requirements and the annual operations and maintenance costs. Total one time mitigation monitoring costs would be approximately $400,000 (DWR 2002).

Chapter 6.0 Recreation

Background

CALFED's Preferred Program Alternative may have potentially significant effects on recreation. The CALFED ROD outlined mitigation measures that will reduce potential effects of the Preferred Program Alternative implementation on recreation. The mitigation measures included incorporating project-level recreation improvements and enhancements, providing access to waterfront areas and island edges, creating new day-use boating and camping areas, etc. The May 2002 Planning Study Report on Environmental Evaluations contained an evaluation of the recreation proposed for the DW Project from a public perspective. The report concluded that the recreation proposed by DW Properties was not appropriate for a publicly owned and operated project. Staff recommended changes to the proposed recreation based on the Sacramento-San Joaquin Delta Recreation Survey (DPR 1997) which identified unmet recreational needs in the Delta. Findings of the survey were used to identify unmet needs that could be accommodated on the islands and levees of the In-Delta Storage project, and could be managed as public opportunities. In addition to providing project-level recreation improvements, the changes recommended included providing access to islands edges and creating new day-use boating areas.

Davis-Dolwig Act

In addition to the guidance provided by the CALFED ROD, the planning and development of recreation facilities associated with state water projects[5] are guided by the Davis-Dolwig Act and Resources Agency Order 6 dated March 6, 1963, entitled "Planning, Development, and Operation Recreation and Fish and Wildlife Facilities at State Water Project." The Davis-Dolwig Act (Act) (Water Code Section 11900 et seq.), enacted in 1961, declares that recreation and the enhancement of fish and wildlife resources are among the purposes of state water projects and acquisition of real property for such purposes be planned concurrently with the project. The Act applies to water storage projects constructed by the State or by the State in cooperation with the Federal government. The Act sets forth the responsibilities of DWR, Department of Parks and Recreation (Parks), Department of Fish and Game (DFG), the Department of Boating and Waterways (DBW), and the Wildlife Conservation Board as to planning, construction, and

[5] The In-Delta Storage Project is being evaluated as part of the State Water Project and/or the Central Valley Project for the purposes of the State Feasibility Study.

operation of recreation facilities and fish and wildlife resources at state water projects. Under the Act, the General fund is to pay for such costs of fish and wildlife enhancement and recreation.

DWR's responsibilities under the Act include planning for recreation and for fish and wildlife preservation (mitigation) and enhancement, and acquiring land for such uses. The recreational features mentioned in the Act include campgrounds, picnic areas, water and sanitary facilities, parking areas, viewpoints, boat launching ramps, and any others necessary to make project land and water areas available for use by the public. DWR planning for public recreation use and fish and wildlife preservation and enhancement is to be part of the general project formulation activities and done in close coordination, consultation, and cooperation with Parks, DFG, Department of Boating and Waterways, and all appropriate federal and local agencies. DWR is to give full consideration to the recommendations provided by such other departments and agencies.

DWR planning described under the Act includes and is not limited to, the development of data on benefits and costs, recreation land use planning, and the acquisition of land. As appropriate for project formulation purposes, DWR would be responsible for preparing a report describing the project and, if the project is economically justified, requesting financing.

The Act requires that water supply beneficiaries pay for the fish and wildlife preservation (mitigation) costs of the state water project and that the State General Fund pay the costs of the benefits enjoyed by the general public, described as recreational development and fish and wildlife enhancements. Therefore, DWR must not include the costs of the development of public recreation or the enhancement of fish and wildlife in the prices, rates and charges for water and power (Water Code Section 11912). In other words, the costs of recreation and fish and wildlife enhancement are not reimbursable costs under the State Water Project long-term water supply contracts. Water Code Section 11913 declares the intent that such costs are to be paid from the State General Fund. In addition, Agency Order Number 6 states that the costs of performance of the respective responsibilities of DWR, Parks, and DFG under the Act is subject to the availability of funds.

Under the Act, Parks is responsible for the design, construction, operation, maintenance, and management of public recreation facilities at state water projects, except for boating facilities, which DBW is responsible for planning, designing and constructing. Parks must submit its plans for public recreation facilities to local government agencies that have jurisdiction over the area involved. Parks is authorized to enter into contracts with the United States, local public agencies, or other entities, to ensure maximum development of the recreation at state water projects. The design, construction, operation, maintenance, and management of such recreation facilities at state water projects is subject to DWR approval to ensure they will not defeat or impair the orderly operation of the State Water Project for its other project purposes (water supply and power development).

Under the Act, DFG is to manage fish and wildlife resources at state water projects, including any such additional resources as are created by such projects, in a manner compatible with other project uses. DFG may enter into agreements with DWR to undertake or supervise fish and wildlife enhancement measures or facilities included in state water project plans for those measures or facilities, which are normally considered within the managerial or technical abilities of DFG.

Recreation and the Revised Habitat Management Plan

The recreation proposed for the In-Delta Storage Project was described in the In-Delta Storage Program Planning Study Report on Environmental Evaluations (CALFED 2002). Changes to the recreation plan may be made during the Subsequent EIR/EIS and ESA/CESA consultation process, and during discussions with Parks, DBW and local agencies. Potential conflicts may exist between the proposed hunting and sandhill crane use on the habitat islands. Boat dock placement should consider the existing special status plant populations on all levees. It should be possible to modify the recreation plan to accommodate both recreation and threatened and endangered species needs.

Chapter 7.0 Cultural Resources

Background

A substantial amount of previous cultural resource compliance work has been conducted for the Delta Wetlands Project. The previous cultural resource studies were conducted from 1988 - 1993 and were conducted in accordance with the requirements of Section 106 of the National Historic Preservation Act. Delta Wetlands Properties identified sensitive cultural resources on all the project islands. Significant archaeological sites exist within project lands on Bouldin Island, Bacon Island, and Holland Tract. Areas of sensitive soils potentially containing prehistoric human remains exist on Webb Tract and Holland Tract.

The identification of significant cultural resources and areas sensitive for prehistoric archaeological remains led to the 1998 *Programmatic Agreement Among the U.S. Army Corps of Engineers, California State water Resources Control Board, California State Historic Preservation Officer, Advisory Council on Historic Preservation, and Delta Wetlands Properties Regarding the Implementation of the Delta Wetlands Project* to ensure adequate treatment of historic properties. The 2002 In-Delta Storage Project Study Report on Environmental Evaluations built upon the programmatic agreement and recommended that DWR re-initiate Section 106 consultations, update the Programmatic Agreement (PA), re-survey Piper Sands and conduct data recovery excavations. The In-Delta Storage Project Study Report also acknowledged the need to develop a Historic Properties Management Plan (HPMP), as outlined in the PA, to mitigate the adverse effects of the project on historic properties and to address the management of cultural resources once the proposed project has been implemented. DWR and BOR agreed to have DW consultants prepare a HPMP that would serve the In-Delta Storage Project or the DW project, whichever proposal successfully went forward. DWR and BOR met with the DW consultants in the fall of 2002 to discuss the content of the HPMP; the draft HPMP (Wee et al. 2003) was completed in January 2003.

Historic Property Management Plan

The HPMP closely matches the 2002 In-Delta Storage Project Study Report recommendations with few variations. A comparison of the salient points is presented below.

Webb Tract

The 2002 In-Delta Storage Project Study Report recommended that the Piper Sands on Webb Tract be re-surveyed for archaeological resources prior to implementation of the Delta Wetlands project. Should archaeological sites be identified, they would require evaluation for significance.

The HPMP also recommends that a reassessment of these soils but, in addition to survey/surface examination, it calls for trenching of the Piper Sands to identify the presence of buried deposits and, more specifically, human interments. Trenching would focus on Piper Sands above sea level and it is proposed that 15 to 20 trenches, measuring between 3 and 10 feet long, be excavated to a depth of 10 to 15 feet below the surface. The HPMP further recommends that the Piper Sands be monitored for the possible exposure of human remains from erosion after the project has been implemented. Thus the HPMP proposes additional, but appropriate, assessment and monitoring measures in comparison to the In-Delta Storage Project Study Report.

Holland Tract

As at Webb Tract, the 2002 In-Delta Storage Project Study Report recommended that the Piper Sands on Holland Tract be resurveyed for archaeological remains and, should any sites be identified, that they be evaluated for significance. The Study Report also recommended that all previously-identified sites be revisited and that records for each site be updated. Even though two previously-recorded sites on Holland Tract have been determined ineligible for the National Register, due to the known presence of human remains at the sites, it was proposed that some form of mitigation be carried out at those sites prior to implementation of the Delta Wetlands project, if the sites could not be avoided. DWR continues to recommend this level of documentation.

The HPMP proposes somewhat less work for Holland Tract. The HPMP recommends that one site, CA-CCO-593, be monitored for the possible exposure of human remains after the Delta Wetlands project has been implemented.

Bacon Island

Given the presence of a Rural Historic District on Bacon Island, the 1998 PA and the 2002 In-Delta Storage Project Study Report recommended a number of measures to mitigate the effects of the Delta Wetlands project on the historic cultural resources. The only significant difference between the In-Delta Storage Project Study Report and the HPMP pertains to the level of data recovery at the historic-era archaeological sites contained within the Historic District. The Study Report proposed that data recovery activities be conducted at each of the ten archaeological sites located there. The HPMP, on the other hand, proposes data recovery efforts at only six of the sites. This recommendation comes as the result of conducting minor shovel probes at the sites to determine the presence of a subsurface deposit, whereby a sufficient deposit was identified at six of the ten sites. Additional mitigation activities, such as recording the architectural features of the Historic District according to the Secretary of the Interior's Standards and Guidelines for Architectural and Engineering Documentation: HABS/HAER Standards, the production of an educational documentary and a public education publication are consistent with the requirements of the PA and the recommendations of the In-Delta Storage Project Study Report.

Bouldin Island

One historic-era archaeological site on Bouldin Island has been determined eligible for the National Register of Historic Places. Both the 2002 In-Delta Storage Project Study Report and the HPMP recommend data recovery for this site.

The HPMP provides greater detail than the 2002 In-Delta Storage Project Study Report for conducting some required tasks (e.g, Native American consultation, activities related to unexpected archaeological finds, etc.), all of which is consistent with the requirements of the PA.

Chapter 8.0 Hazardous Materials

In 2002 the In-Delta Storage Project Planning Study Report on Environmental Evaluations, DWR staff provided results from a modified Phase I Environmental Site Assessment (ESA). Results from the Phase I ESA indicated that conditions on Bouldin Island, Holland Tract, Webb Tract and Bacon Island will require remediation before the islands can be used for either reservoir storage or habitat mitigation. Staff recommended a Phase II ESA to determine the extent that conditions on the islands require remediation and to establish state and federal liability for future cleanup and remediation.

DWR staff completed a Phase II ESA in the fall of 2003. The purpose of this Phase II ESA was to evaluate the nature and extent of suspected hazardous substance contamination at sites identified in the modified Phase I ESA. The Phase II ESA was performed in accordance with standards prescribed in American Society for Testing and Materials Designation E 1903-97 and DWR guidelines.

In the Phase II ESA, DWR Site Assessment staff collected a total of 77 soil samples at the sites. High levels of petroleum hydrocarbons, such as oil and grease, were detected at the vehicle and farm equipment maintenance facilities, especially in areas around or near fuel and lubricating oil tanks. Low concentrations of other potential contaminants, such as heavy metals, chlorinated pesticides, and organic solvents were also detected. However, in each instance, their levels never exceeded the Total Threshold Limit Concentrations as established in Title 22 of the California Code of Regulations.

Based on the results of the Phase II ESA sampling, DWR Site Assessment staff recommends further investigation of the identified “hot spot” areas to better delineate the extent of contamination. Further investigation may include more invasive subsurface soil sampling, surface water and groundwater sampling, and environmental fate studies for each of the contaminants of concern. DWR Site Assessment staff also recommends that any contaminated soil at or near water supply well sites be removed and properly disposed of, or remediated, depending on the extent of contamination.

Lastly, DWR Site Assessment staff recommends that all measures be taken to indemnify the State from any liability associated with future hazardous substance contamination or remedial actions associated with the natural gas wells that are present throughout the Site. At this time, these gas wells and the parcels on which they are situated may not be part of the land acquisition for the Project. Such measures may include establishing baseline soil and groundwater sampling data for the properties surrounding the gas wells or inserting indemnification clauses in each of the proposed purchase agreements.

Methods and results from the Phase II ESA are provided in the Phase II Environmental Site Assessment draft report in Appendix E.

Chapter 9.0 Aquatic Resources

Nine listed or sensitive fish species occur in the In-Delta Storage Project area that could be affected by the project. The species include chinook salmon, delta smelt, splittail and Central Valley steelhead. A California Endangered Species Act Incidental Take Permit issued by the Department of Fish and Game, the U.S. Fish and Wildlife Service and National Marine Fisheries Service (NOAA Fisheries) biological opinions, and the State Water Resources Control Board Decision 1643 included provisions in the Delta Wetlands Project (DW) permit to protect them. In general, impacts could be adverse or beneficial. These are related to: changes in channel water temperature, dissolved oxygen concentrations, outflow and flow patterns, salinity and organic carbon, transport flows, increased entrainment of eggs and larvae, and changes in total mercury or methyl mercury concentrations in water and biota due to reservoir and habitat island operations.

DW Final Operations Criteria were developed to ensure that project operations do not jeopardize the continued existence of delta smelt, splittail, chinook salmon or Central Valley steelhead. Other species are also expected to benefit from the Final Operations Criteria. As long as the Final Operations Criteria are met, adverse impacts to listed fish species are considered less than significant. The 1997 DW Project fish screen design did not meet DFG 2000 Fish Screening Criteria. Therefore, the proposed DW design required modification to meet current criteria. The fish screens were redesigned to bring the screens into compliance with current standards that meet the restrictions in the Final Operations Criteria, biological opinions, and incidental take permit.

The delta smelt diversion criteria in D 1643 results in reduction of project yield. Details of operational runs for fisheries operations are given in Chapter 3 of the 2003 Operations Study Report. Recently, the California Farm Bureau Federation reached a settlement agreement in their lawsuit against the U.S. Fish and Wildlife Service when the Service agreed to complete a five year status review. The California Farm Bureau Federation claims that current delta smelt recovery criteria are based on unjustified abundance and distribution assumptions. Developing current size and distribution estimates for delta smelt abundance is difficult. Predicting the size and distribution of delta smelt abundance well into the future is an area of even more uncertainty. Any future negotiated changes in the criteria should be incorporated in the reservoir operations.

Additionally, further analysis is required to narrow down the uncertainty due to changes in the Dissolved Oxygen (DO) levels as a result of the project operations. Predicting DO levels for specific areas would require estimations of highly variable and complex biological dynamics.

Species in the Project Area

The In-Delta Storage project could have positive and negative effects on protected fish species in the Bay-Delta. According to the California Natural Diversity Database records, and species lists provided by USFWS and DFG, there are seven threatened or endangered fish species, two candidates for listing, and five species of special concern that could be in the project area. A list of these special status fish species is provided in Table 9.1. Brief descriptions of the life histories of these species and specific discussion on how the project could affect these species was provided in the In-Delta Storage Program Planning Study Report on Environmental Evaluations, May 2002. Additional fisheries impact analyses will be needed as changes in reservoir operations are proposed in project development. For example, a flow-through, circulation operation proposed for the reservoirs might change how the project could affect fish species in the channels surrounding reservoir islands. Increases in certain types of organic carbon in the surrounding channels could also prove beneficial to the species.

Table 9-1. Special status species for the In-Delta Storage Project

Common Name	Scientific Name	Federal Status	State Status
Winter-Run Chinook Salmon	*O. tshawytscha*	Endangered	Endangered
Spring-Run Chinook Salmon	*O. tshawytscha*	Threatened	Threatened
Late Fall-Run Chinook Salmon	*O. tshawytscha*	Candidate	Special Concern
Fall-Run Chinook Salmon	*O. tshawytscha*	Candidate	Special Concern
Central CA Coastal Coho Salmon	*O. kisutch*	Threatened	Endangered[a]
Central CA Coastal Steelhead	*O. mykiss*	Threatened	None
Central Valley Steelhead	*O. mykiss*	Threatened	None
Delta Smelt	*H. transpacificus*	Threatened	Threatened
Splittail	*P. macrolepidotus*	Threatened	Special Concern
Longfin Smelt	S. thaleichthys	Special Concern	None
Green Sturgeon	*A. medirostris*	Candidate	None
River Lamprey	*L. ayresi*	Special Concern	None
Kern Brook Lamprey	*L. hubbsi*	Special Concern	None
Pacific Lamprey	*L. tridentata*	Special Concern	None
[a]Not included in the DFG Species List for In-Delta Storage			

Fish Screens Design Coordination

DWR met with the Central Valley Fish Facilities Review Team (CVFFRT) on January 17, 2003 and on February 13, 2003 to solicit technical comments and suggestions on the proposed design and layout of In-Delta Storage project fish screening facilities. Technical experts from various resource agencies provided suggestions to improve the fish screen design and layout, which were incorporated into the plans. The CVFFRT recommended that a technical review committee on the In-Delta Storage Project fish screens be set up in later stages of the project. For specific information on the fish screens design refer to the In-Delta Storage Program Draft Engineering Investigations Summary, June 2003.

Shallow Water Habitat Impacts and Mitigation

The In-Delta Storage project includes strengthening levees by placing rock on the riverside of the reservoir islands to assure levee stability. Preliminary estimates are that levee protection measures could eliminate 80 acres of shallow water habitat from the perimeters of Bacon Island and Webb Tract. Mitigation cost estimates for the loss of shallow water habitat is 2 million dollars. Additional analysis will be conducted to determine the specific impacts to shallow water habitat once the levee protection measures and recreation development plans are refined. Also, DWR will consult and coordinate with resource agencies to develop a shallow water habitat mitigation strategy.

Chapter 10.0 Conclusions

Recommendations

- Determine the implications of acquiring 10,003 acres of agricultural easements on the financial feasibility of the In-Delta Storage Project and the implementation of ERP actions in the Delta.
- Develop the information required of state agencies under the Williamson Act (notice and findings).
- Continue discussions on agricultural mitigation options with the DPC, DOC, Contra Costa County and San Joaquin County
- Develop a mitigation plan for unavoidable impacts to special status plant populations, in consultation with DFG and USFWS.
- Determine the quantities and types of wildlife habitats currently present on the Project islands.
- Coordinate with wildife agencies to determine the appropriate means of achieving endangered species acts compliance.
- Investigate identified hazardous materials "hot spot" areas to better delineate the extent of contamination.
- The proposed changes in the Project diversions and operations being different than the ones allowed in the SWRCB Decision 1643, a subsequent EIR/EIS would be required for any changes in environmental impact evaluations.
- Due to their strategic location, the operation of the island reservoirs may contribute to an incremental improvement in habitat quality and availability for fish and other aquatic organisms inhabiting the Bay-Delta system. On the other hand, there may be adverse impacts in some areas. Fisheries impact analyses should be conducted for future changes in reservoir operations.
- Organize a technical review committee for In-Delta Storage Project fish screens review during the preliminary and final design phases.
- Coordinate with fishery agencies to determine the appropriate means of achieving endangered species acts compliance.

Mitigation Cost Estimates

A summary of the mitigation measures and costs estimates for the In-Delta Storage Project is given in Tables 10-1 and 10-2.

Table 10-1. Estimated Initial Environmental Mitigation and monitoring costs for the In-Delta Storage Project

Mitigation and Monitoring	Initial Cost
Purchase conservation easements (3,900 acres)	$ 4,680,000
Cultural resources mitigation	$ 945,000
Recreation	$ 3,200,000
Environmental Site Assessment	$ 135,000
Slough side mitigation	$ 2,000,000
Habitat Island development and construction	$23,490,653
Total Cost	**$34,450,653**

Table 10-2. Estimated Annual On-Going Costs for Environmental Mitigation, Monitoring and Weed Control for the In-Delta Storage Project

Mitigation and Monitoring	Annual Costs
Habitat island and Fisheries monitoring and operations and maintenance	$1,700,000
Cultural resources mitigation	$10,000
Invasive weed control on reservoir islands	$722,016
Recreation facilities operation and maintenance	$265,000
Total annual costs	**$2,697,016**

Chapter 11.0 References

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Appendix A. LESA Evaluation Worksheets

Bacon Island

Land Evaluation Worksheet

Land Capability Classification (LCC) and Storie Index Scores

A Soil Map Unit	B Project Acres	C Proportion of Project Area	D LCC	E LCC Rating	F LCC Score	G Storie Index	H Storie Index Score
Itano silty clay loam	140	0.024	3W	60	1.44	43	1.032
Kingle muck	1451	0.254	3W	60	15.24	32	8.128
Kingle-Ryde complex	477	0.084	3W	60	5.04	36	3.024
Rindge muck	2624	0.459	3W	60	27.54	40	18.36
Rindge mucky silt loam	94	0.016	3W	60	0.96	47	0.752
Ryde clay loam	390	0.068	3W	60	4.08	40	2.72
Totals	See page 2	(Must Sum to 1.0)		***LCC Total Score***	See page 2	***Storie Index Total Score***	See page 2

Site Assessment Worksheet 1.

Project Size Score

	I LCC Class I - II	J LCC Class III	K LCC Class IV - VIII
		140	
		1451	
		477	
		2624	
		94	
		390	
Total Acres		See page 2	
Project Size Scores			
Highest Project Size Score			

Bacon Island

Land Evaluation Worksheet

Land Capability Classification (LCC) and Storie Index Scores

A	B	C	D	E	F	G	H
Soil Map Unit	Project Acres	Proportion of Project Area	LCC	LCC Rating	LCC Score	Storie Index	Storie Index Score
Ryde silty clay loam	267	0.047	3W	60	2.82	43	2.021
Ryde-Peltier complex	69	0.012	3W	60	0.72	38	0.456
Venice muck	60	0.011	3W	60	0.66	40	0.44
Venice mucky silt loam	141	0.025	3W	60	1.5	47	1.175
Totals	5713	(Must Sum to 1.0) 1.0		***LCC Total Score***	60	***Storie Index Total Score***	38.108

Site Assessment Worksheet 1.

Project Size Score

	I	J	K
	LCC Class I - II	LCC Class III	LCC Class IV - VIII
		267	
		69	
		60	
		141	
Total Acres		5713	
Project Size Scores		100	
Highest Project Size Score		100	

Bacon Island

Site Assessment Worksheet 2. - Water Resources Availability

A	B	C	D	E
Project Portion	Water Source	Proportion of Project Area	Water Availability Score	Weighted Availability Score (C x D)
1	Riparian	1.0	100	100
2				
3				
4				
5				
6				
		(Must Sum to 1.0)	***Total Water Resource Score***	100

Note: Bacon Island has both riparian and appropriative water rights. The irrigation system is set up so that Bacon Island can be fully irrigated by either riparian or appropriative water rights (Forkel 2003 personal communication; see "Notes").

Bacon Island

Site Assessment Worksheet 3.

Surrounding Agricultural Land and Surrounding Protected Resource Land

A	B	C	D	E	F	G
Zone of Influence						
Total Acres	Acres in Agriculture	Acres of Protected Resource Land	Percent in Agriculture (A/B)	Percent Protected Resource Land (A/C)	Surrounding Agricultural Land Score (From Table)	Surrounding Protected Resource Land Score (From Table)
21941	10813	9438	49%	43%	20	10

See Figures 1-3 for zone of influence, and the surrounding agricultural and protected resource land within the zone of influence.

Calculations done according to 1997 LESA instruction manual accessed 4/30/03 at http://www.consrv.ca.gov/DLRP/LESA/lesamodl.pdf

Surrounding agricultural land and surrounding protected resource land scores taken from Tables 6 and 7 in manual listed above.

LESA Worksheet (cont.)

NOTES

Determination: The project's conversion of Bacon Island agriculture to reservoir storage is a significant impact according to Table 9 in the 1997 LESA manual.

Final LESA Score Sheet

Calculation of the Final LESA Score:

(1) Multiply each factor score by the factor weight to determine the weighted score and enter in Weighted Factor Scores column.
(2) Sum the weighted factor scores for the LE factors to determine the total LE score for the project.
(3) Sum the weighted factor scores for the SA factors to determine the total SA score for the project.
(4) Sum the total LE and SA scores to determine the Final LESA Score for the project.

	Factor Scores	Factor Weight	Weighted Factor Scores
LE Factors			
Land Capability Classification	<1> 60	0.25	15
Storie Index	<2> 38	0.25	10
LE Subtotal		***0.50***	25
SA Factors			
Project Size	<3> 100	0.15	15
Water Resource Availability	<4> 100	0.15	15
Surrounding Agricultural Land	<5> 20	0.15	3
Protected Resource Land	<6> 10	0.05	0.5
SA Subtotal		***0.50***	34
		Final LESA Score	59

For further information on the scoring thresholds under the California Agricultural LESA Model, consult Section 4 of the Instruction Manual.

Webb Tract

Land Evaluation Worksheet

Land Capability Classification (LCC) and Storie Index Scores

A	B	C	D	E	F	G	H
Soil Map Unit	Project Acres	Proportion of Project Area	LCC	LCC Rating	LCC Score	Storie Index	Storie Index Score
Kingle muck	37	0.007	3W	60	0.42	32	0.224
Merritt loam	142	0.026	2W	80	2.08	60	1.56
Piper fine sandy loam	263	0.048	4W	40	1.92	23	1.104
Piper loamy sand	11	0.002	3S	60	0.12	32	0.064
Rindge muck	4399	0.809	3W	60	48.54	40	32.36
Ryde silt loam	489	0.090	3W	60	5.4	50	4.5
Totals	See page 2	(Must Sum to 1.0)		***LCC Total Score***	See page 2	***Storie Index Total Score***	See page 2

Site Assessment Worksheet 1.

Project Size Score

	I	J	K
	LCC Class I - II	LCC Class III	LCC Class IV - VIII
		37	
	142		
			263
		11	
		4399	
		489	
Total Acres	See page 2	See page 2	See page 2
Project Size Scores			

Highest Project Size Score

Webb Tract

Land Evaluation Worksheet

Land Capability Classification (LCC) and Storie Index Scores

A	B	C	D	E	F	G	H
Soil Map Unit	Project Acres	Proportion of Project Area	LCC	LCC Rating	LCC Score	Storie Index	Storie Index Score
Shima muck	100	0.018	3W	60	1.08	32	0.576
Totals	5441	(Must Sum to 1.0) 1.0		***LCC Total Score***	60	***Storie Index Total Score***	40

Site Assessment Worksheet 1.

Project Size Score

	I	J	K
	LCC Class I - II	LCC Class III	LCC Class IV - VIII
		100	
Total Acres	142	5036	263
Project Size Scores	100	100	80
Highest Project Size Score		100	

Webb Tract

Site Assessment Worksheet 2. - Water Resources Availability

A	B	C	D	E
Project Portion	Water Source	Proportion of Project Area	Water Availability Score	Weighted Availability Score (C x D)
1	Riparian	1.0	100	100
2				
3				
4				
5				
6				
		(Must Sum to 1.0)	***Total Water Resource Score***	100

Note: Webb Tract has both riparian and appropriative water rights. The irrigation system is set up so that Webb Tract can be fully irrigated by either riparian or appropriative water rights (Forkel 2003 personal communication; see "Notes").

Webb Tract

Site Assessment Worksheet 3.
Surrounding Agricultural Land and Surrounding Protected Resource Land

A	B	C	D	E	F	G
Zone of Influence						
Total Acres	Acres in Agriculture	Acres of Protected Resource Land	Percent in Agriculture (A/B)	Percent Protected Resource Land (A/C)	Surrounding Agricultural Land Score (From Table)	Surrounding Protected Resource Land Score (From Table)
18339	6003	7080	33%	39%	0	0

See Figures 1-3 for zone of influence, and the surrounding agricultural and protected resource land within the zone of influence.

Calculations done according to 1997 LESA instruction manual accessed 4/30/03 at http://www.consrv.ca.gov/DLRP/LESA/lesamodl.pdf

Surrounding agricultural land and surrounding protected resource land scores taken from Tables 6 and 7 in manual listed above.

LESA Worksheet (cont.)

NOTES

Determination: The project's conversion of Webb Tract agriculture to reservoir storage is a significant impact according to Table 9 in the 1997 LESA manual.

Final LESA Score Sheet

Calculation of the Final LESA Score:

(1) Multiply each factor score by the factor weight to determine the weighted score and enter in Weighted Factor Scores column.
(2) Sum the weighted factor scores for the LE factors to determine the total LE score for the project.
(3) Sum the weighted factor scores for the SA factors to determine the total SA score for the project.
(4) Sum the total LE and SA scores to determine the Final LESA Score for the project.

	Factor Scores	Factor Weight	Weighted Factor Scores
LE Factors			
Land Capability Classification	<1> 60	0.25	15
Storie Index	<2> 40	0.25	10
LE Subtotal		***0.50***	25
SA Factors			
Project Size	<3> 100	0.15	15
Water Resource Availability	<4> 100	0.15	15
Surrounding Agricultural Land	<5> 0	0.15	0
Protected Resource Land	<6> 0	0.05	0
SA Subtotal		***0.50***	30
		Final LESA Score	55

For further information on the scoring thresholds under the California Agricultural LESA Model, consult Section 4 of the Instruction Manual.

Appendix B. Plant Species Found During 2002 Botanical Surveys on In-Delta Storage Project Islands

Scientific name	Common name	Native	status/list
FERNS AND FERN ALLIES			
AZOLLACEAE			
Azolla filiculoides	water fern	y	
DENNSTAEDIACEAE			
Pteridium aquilinum var. pubescens	bracken fern	y	
EQUISETACEAE			
Equisetum arvense	common horsetail	y	
Equisetum laevigatum	smooth scouring rush	y	
DICOTS			
ACERACEAE			
Acer negundo	box elder	y	
AMARANTHACEAE			
Amaranthus retroflexus	redroot pigweed	n	
ANACARDIACEAE			
Toxicodendron diversilobum	poison oak	y	
APIACEAE			
Anthriscus caucalis	bur-chervil	n	
Ciclospermum leptophyllum	ciclospermum	n	
Conium maculatum	poison hemlock	n	
Foeniculum vulgare	fennel	n	
Hydrocotyle verticillata	hydrocotyle	y	
Lilaeopsis masonii	Mason's lilaeopsis	y	FSC/CR/1B
APOCYNACEAE			
Apocynum cannabinum	Indian hemp	y	
ASTERACEAE			
Acroptilon repens	Russian knapweed	n	
Anthemis cotula	mayweed	n	
Artemisia douglasiana	mugwort	y	
Aster lentus	Suisun marsh aster	y	FSC/--/1B
Baccharis pilularis	coyote-bush	y	
Bidens frondosa	sticktight	y	
Bidens laevis	bur-marigold	y	
Carduus pycnocephalus	Italian thistle	n	
Centaurea solstitialis	yellow star-thistle	n	
Cichorium intybus	chicory	n	
Cirsium vulgare	bull thistle	n	
Conyza canadensis	horseweed	y	
Cotula australis	small brass buttons	n	
Cotula coronopifolia	brass buttons	n	
Euthamia occidentalis	western goldenrod	y	

Gnaphalium luteo-album	cudweed	n
Helianthus annuus	common sunflower	y
Helenium puberulum	sneezeweed	y
Hemizonia pungens ssp. pungens	common spikeweed	y
Heterotheca grandiflora	telegraph weed	y
Hypochaeris glabra	smooth cat's ear	n
Hypochaeris radicata	rough cat's ear	n
Lactuca serriola	prickly lettuce	n
Picris echioides	bristly ox-tongue	n
Pluchea odorata	salt marsh fleabane	y
Silybum marianum	milk thistle	n
Sonchus asper	spiny sowthistle	n
Sonchus oleraceus	sow thistle	n
Tragopogon dubius	western salsify	n
Xanthium spinosum	spiny cocklebur	y
Xanthium strumarium	cocklebur	y
BETULACEAE		
Alnus rhombifolia	alder	y
BORAGINACEAE		
Myosotis laxa	forget-me-not	y
Amsinckia menziesii var. intermedia	common fiddleneck	y
Amsinckia menziesii var. menziesii	rancher's fireweed	y
Heliotropium curassavicum	heliotrope	y
BRASSICACEAE		
Brassica nigra	black mustard	n
Lepidium latifolium	peppergrass	n
Raphanus raphanistrum	jointed charlock	n
Raphanus sativus	wild radish	n
Rorippa palustris var. occidentalis	yellow cress	y
CARYOPHYLLACEAE		
Spergularia bocconei	sandspurry	n
CAPRIFOLIACEAE		
Lonicera involucrata var. ledebourii	twinberry	y
Sambucus mexicana	blue elderberry	y
CERATOPHYLLACEAE		
Ceratophyllum demersum	hornwort	y
CHENOPODIACEAE		
Chenopodium album	pigweed	n
Salsola tragus	Russian thistle	n
CONVOLVULACEAE		
Calystegia sepium ssp. limnophila	hedge bindweed	y
Convolvulus arvensis	bindweed	n
CRASSULACEAE		

Crassula aquatica	water pygmy weed	y	
CUSCUTACEAE			
Cuscuta sp.	dodder	y	
EUPHORBIACEAE			
Eremocarpus setigerus	doveweed	y	
FABACEAE			
Acacia decurrens	green wattle	n	
Glycyrrhiza lepidota	wild licorice	y	
Hoita macrostachya	hoita	y	
Lathyrus jepsonii var. californica	California pea	n	
Lathyrus jepsonii var. jepsonii	delta tule pea	y	FSC/--/1B
Lotus corniculatus	birdfoot trefoil	n	
Lotus purshianus var. purshianus	Spanish clover	y	
Medicago polymorpha	bur clover	n	
Medicago sativa	alfalfa	n	
Melilotus alba	white sweet clover	n	
Melilotus indica	sourclover	n	
Trifolium hirtum	rose clover	n	
FAGACEAE			
Quercus lobata	valley oak	y	
GERANIACEAE			
Erodium cicutarium	filaree	n	
HALORAGACEAE			
Myriophyllum aquaticum	parrot's feather	n	
Myriophyllum spicatum	Eurasian water-milfoil	n	
JUGLANDACEAE			
Carya illinoiensis	pecan	n	
Juglans californica var. hindsii	black walnut	y	
LAMIACEAE			
Marrubium vulgare	horehound	n	
Mentha arvensis	wild mint	y	
Stachys albens	white hedge nettle	y	
LYTHRACEAE			
Lythrum californicum	California loosestrife	y	
Lythrum hyssopifolium	lythrum	n	
MALVACEAE			
Abutilon threophrasti	velvet-leaf	n	
Hibiscus lasiocarpus	rose-mallow	y	--/--/1B
Malva nicaensis	bull mallow	n	
Malva parviflora	cheeseweed	n	
Malvella leprosa	alkali mallow	n	

MORACEAE			
Ficus carica	edible fig	n	
MYRTACEAE			
Eucalyptus globulus	blue gum	n	
ONAGRACEAE			
Epilobium brachycarpum	fireweed	y	
Ludwigia peploides ssp. peploides	water primrose	y	
PAPAVERACEAE			
Eschscholzia californica	California poppy	y	
PLANTAGINACEAE			
Plantago major	common plantain	n	
POLYGONACEAE			
Polygonum amphibium var. emersum	water smartweed	n	
Polygonum arenastrum	knotweed	n	
Polygonum hydropiperoides	waterpepper	y	
Polygonum persicaria	lady's thumb	n	
Rumex acetocella	sheep sorrel	n	
Rumex crispus	curly dock	n	
Rumex maritimus	golden dock	y	
PRIMULACEAE			
Samolus parviflorus	water pimpernel	y	
RANUNCULACEAE			
Ranunculus sp.	buttercup	?	
ROSACEAE			
Rosa californica	wild rose	y	
Rubus discolor	Himalayan blackberry	n	
Rubus ursinus	California blackberry	y	
RUBIACEAE			
Cephalanthus occidentalis	buttonbush	y	
Galium trifidum var. pacificum	bedstraw	y	
SALICACEAE			
Populus fremontii ssp. fremontii	fremont cottonwood	y	
Salix exigua	narrow-leaved willow	y	
Salix gooddingii	Goodding's willow	y	
Salix laevigata	red willow	y	
Salix lasiolepis	arroyo willow	y	
Salix lucida	shining willow	y	
SCROPHULARIACEAE			
Castilleja exserta	purple owl's clover	y	
Limosella subulata	delta mudwort	y	--/--/2

Mimulus guttatus	monkeyflower	y	
SIMAROUBACEAE			
Ailanthus altissima	tree-of-heaven	n	
SOLANACEAE			
Datura stramonium	jimson weed	n	
Datura wrightii	datura	y	
Nicotiana glauca	tree tobacco	n	
Solanum elaeagnifolium	silverleaf nightshade	n	
TAMARICACEAE			
Tamarix sp.	tamarisk	n	
URTICACEAE			
Urtica dioica ssp. holosericea	hoary nettle	y	
VERBENACEAE			
Verbena hastata	blue vervain	y	
ZYGOPHYLLACEAE			
Tribulus terrestris	caltrop	n	
MONOCOTS			
ALISMATACEAE			
Sagittaria latifolia	arrowhead	y	
CYPERACEAE			
Carex barbarae	Barbara sedge	y	
Carex vulpinoidea	fox sedge	y	--/--/2
Cyperus eragrostis	umbrella sedge	y	
Eleocharis acicularis	small spikerush	y	
Scirpus acutus var. occidentalis	tule	y	
Scirpus americanus	American bulrush	y	
Scirpus californicus	California bulrush	y	
Scirpus maritimus	three-square	y	
Scirpus microcarpus	small-fruited bulrush	y	
HYDROCHARITACEAE			
Egeria densa	Brazilian waterweed	n	
Elodea canadensis	Canadian waterweed	y	
Hydrilla verticillata	hydrilla	n	
IRIDACEAE			
Iris pseudacorus	yellow water iris	n	
JUNCACEAE			
Juncus acuminatus	sharp-fruited rush	y	
Juncus balticus	baltic rush	y	
Juncus bufonius	toad rush	y	
Juncus effusus var. pacificus	Pacific rush	y	

Juncus mexicanus	Mexican rush	y
Juncus xiphioides	iris-leaved rush	y
LEMNACEAE		
Lemna sp.	duckweed	y
LILIACEAE		
Asparagus officinalis	asparagus	n
POACEAE		
Arundo donax	giant reed	n
Avena fatua	wild oats	n
Avena sativa	slender wild oats	n
Bromus catharticus	rescue grass	n
Bromus diandrus	ripgut brome	n
Bromus madritensis ssp. rubens	red brome	
Cortaderia selloana	pampas grass	n
Crypsis shoenoides	swamp grass	n
Cynodon dactylon	Bermuda grass	n
Digitaria sanguinalis	crabgrass	n
Distichlis spicata	salt grass	y
Echinochloa crus-galli	barnyard grass	n
Echinochloa crus-pavonis	large barnyard grass	n
Holcus lanatus	velvet grass	n
Hordeum marinum ssp. gussoneanum	Mediterranean barley	n
Hordeum murinum ssp. leporinum	hare barley	n
Leymus triticoides	alkali rye	y
Lolium multiflorum	annual ryegrass	n
Lolium perenne	perennial ryegrass	n
Paspalum dilatatum	dallis grass	n
Paspalum urvillei	vasey grass	n
Phalaris sp.	canary grass	n
Phragmites australis	common reed	y
Polypogon monspeliensis	rabbitsfoot grass	n
Sorghum halapense	johnsongrass	n
Taeniatherum caput-medusae	medusa-head	n
Vulpia myuros var. myuros	rattail fescue	n
PONTEDERIACEAE		
Eichhornia crassipes	water hyacinth	n
POTAMOGETONACEAE		
Potamogeton crispus	crispate-leafed pondweed	n
Potamogeton pectinatus	fennel-leaf pondweed	y
Potamogeton pusillus	small pondweed	y
TYPHACEAE		
Sparganium sp.	bur-reed	y
Typha latifolia	broad-leaved cattail	y
Typha sp.	narrow-leaved cattail	y

Appendix C. Bat Habitat Assessment and Preliminary Surveys for the In-Delta Storage Program: Webb Tract, Bacon Island, Holland Tract, and Bouldin Island

TECHNICAL MEMORANDUM

Bat Habitat Assessment and Preliminary Surveys for the In-Delta Storage Program: Webb Tract, Bacon Island, Holland Tract, and Bouldin Island

PREPARED FOR: Leslie Pierce / DWR

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Marjorie Eisert / CH2M HILL

DATE: November 27, 2002

Abstract

Habitat on Webb Tract, Bacon Island, Holland Tract, and Bouldin Island was assessed for bat roosting and foraging suitability as part of impact assessment for the In-Delta Storage Program. Suitable roosting habitat is present on each island in crevices, cavities and foliage found in vegetation and structures. Accessible structures were visually inspected and no roost sites were found. Foraging habitat is present on each island and acoustic surveys at selected sites detected bat activity near water features, riparian vegetation, and open pasture on Bacon Island and Holland Tract. No bats were detected on a single night's survey on Bouldin Island during unfavorable weather. Webb Tract was not surveyed for bat foraging because of access restrictions. Important habitat components were identified including riparian woodlands, lakes and ponds, irrigation canals lined with vegetation, and open pasture with complex vegetation interfaces. Habitat will be lost on Webb Tract and Bacon Island and recommendations were made to create or expand important habitat components on Holland and Bouldin islands. Additional focal species surveys were recommended for Webb Tract and Holland Tract because potential habitat is present but preliminary surveys were insufficient to address the presence of specific species. If presence is assumed mitigation in kind (1:1) should be sufficient. The author does not have a specific reference for the 1:1 mitigation, however, the Army Corps of Engineers requires a 1:1 mitigation ratio for permanent ponds; 2:1 mitigation ratio for the lost of emergent marsh, seasonal wetlands, willow scrub; and a 3:1 mitigation ratio for riparian woodland.

Introduction

Implementation of the In-Delta Storage Program would result in the creation of two reservoir islands, Webb Tract and Bacon Island, and two habitat islands, Holland Tract and Bouldin Island. The reservoir islands would be flooded and existing structures would be removed. The habitat islands would be improved and managed for wildlife under the existing Habitat Management Plan. The Department of Water Resources (DWR) requested that each island be assessed to identify important habitat components for bats and to discuss habitat suitability for special-status bat species. These species are

Townsend's big-eared bat (*Corynorhinus townsendii*), pallid bat (*Antrozous pallidus*), red bat (*Lasiurus blossevillii*), small-footed myotis (*Myotis ciliolabrum*), and Yuma myotis (*M. yumanensis*). This memorandum documents the findings of habitat assessments and preliminary surveys for bats and makes recommendations for future actions regarding these species.

Objectives

The objectives of the habitat assessment as stated in Task Order No. IDS-0502-1841-007 are as follows:

1. Discuss suitability of each island habitat for specific bat species and identify important habitat components. The species identified by the DWR are Townsend's big-eared bat, pallid bat, red bat, small-footed myotis, and Yuma myotis.
2. Discuss potential impacts from flooding the island or removing structures and recommend ways to minimize impacts.
3. Discuss potential impacts from creating the habitat islands.
4. Determine whether specific bat surveys (capture and acoustic sampling) should be completed for each island.

Methods

Habitat assessment on each island was conducted by driving island roads and walking through areas of potential bat habitat. Specific habitat components were investigated for the presence of bats by conducting roost searches and monitoring for foraging activity (Figure 5-19). Land managers, residents, and workers were interviewed regarding bat observations. Two rounds of surveys were conducted in early and late summer on each island to accommodate variation in daily and seasonal bat activity patterns, thus increasing the likelihood of detecting bats, if they are present. DWR assumes some bat species may be present during the winter on the project islands, therefore, winter surveys were not conducted.

Roosting habitat was assessed by identification of crevices and cavities offering protection to bats from weather and predators. On each of the islands, suitable roosting sites were provided primarily by structures (e.g., barns, warehouses, sheds, abandoned homes, pump housings, and bridges) and secondarily by foliage. For structures, assessment consisted of inspections for signs of occupancy, which include roosting bats, urine stains, guano deposits, discarded prey remains, and bat carcasses. Guano deposits of the Townsend's big-eared bat and pallid bat often are immediately recognizable. Foliage was visually assessed but not inspected.

Habitat was considered suitable for foraging if insect prey was available. Assessment of water features and riparian vegetation was emphasized during surveys because they provide foraging opportunities for bats, especially red bats and Yuma myotis. Selected

bat surveys
0
1
2
3
4
Miles

foraging habitat components were acoustically and visually monitored for approximately an hour after sunset. Where access was permitted, surveys were conducted using handheld electronic detectors (Anabat II, New South Wales, Australia) to identify ultrasonic echolocation calls emitted by foraging bats. Surveyors monitored potential habitat components by circling the perimeter, standing within the component, or walking meandering transects through the area. If bat activity was significant, passing bats were spotlighted to note appearance and behavior, and their echolocation calls were monitored using the detector coupled with a laptop computer to view frequency-time sonagrams that aided species identification (Anabat software, Chris Corben, Rohnert Park, California).

A query of the California Natural Diversity Database yielded no occurrence records for bats on any of the islands. Incidental wildlife species observed during habitat assessment surveys are included in Appendix A.

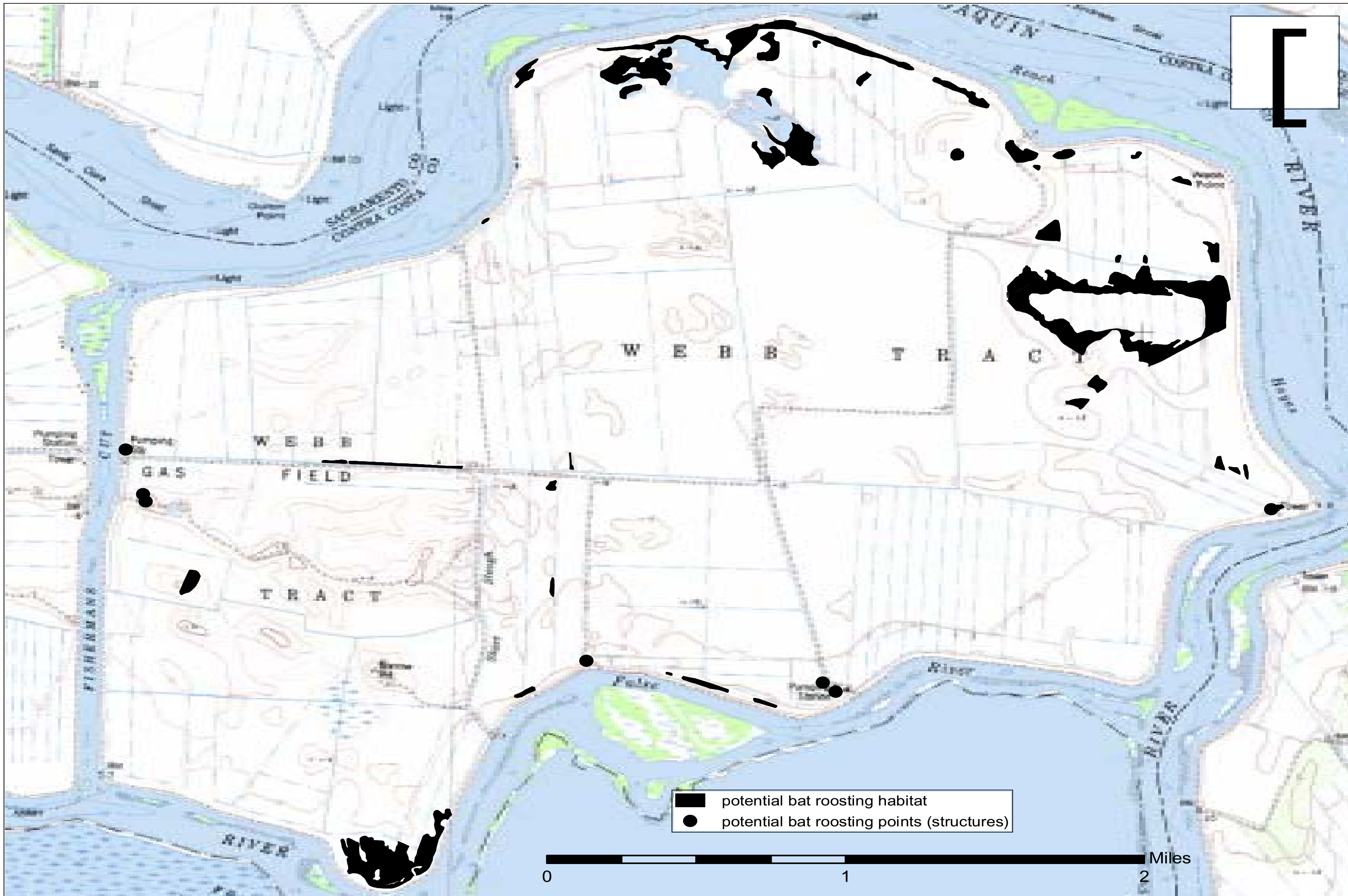
Results

Webb Tract

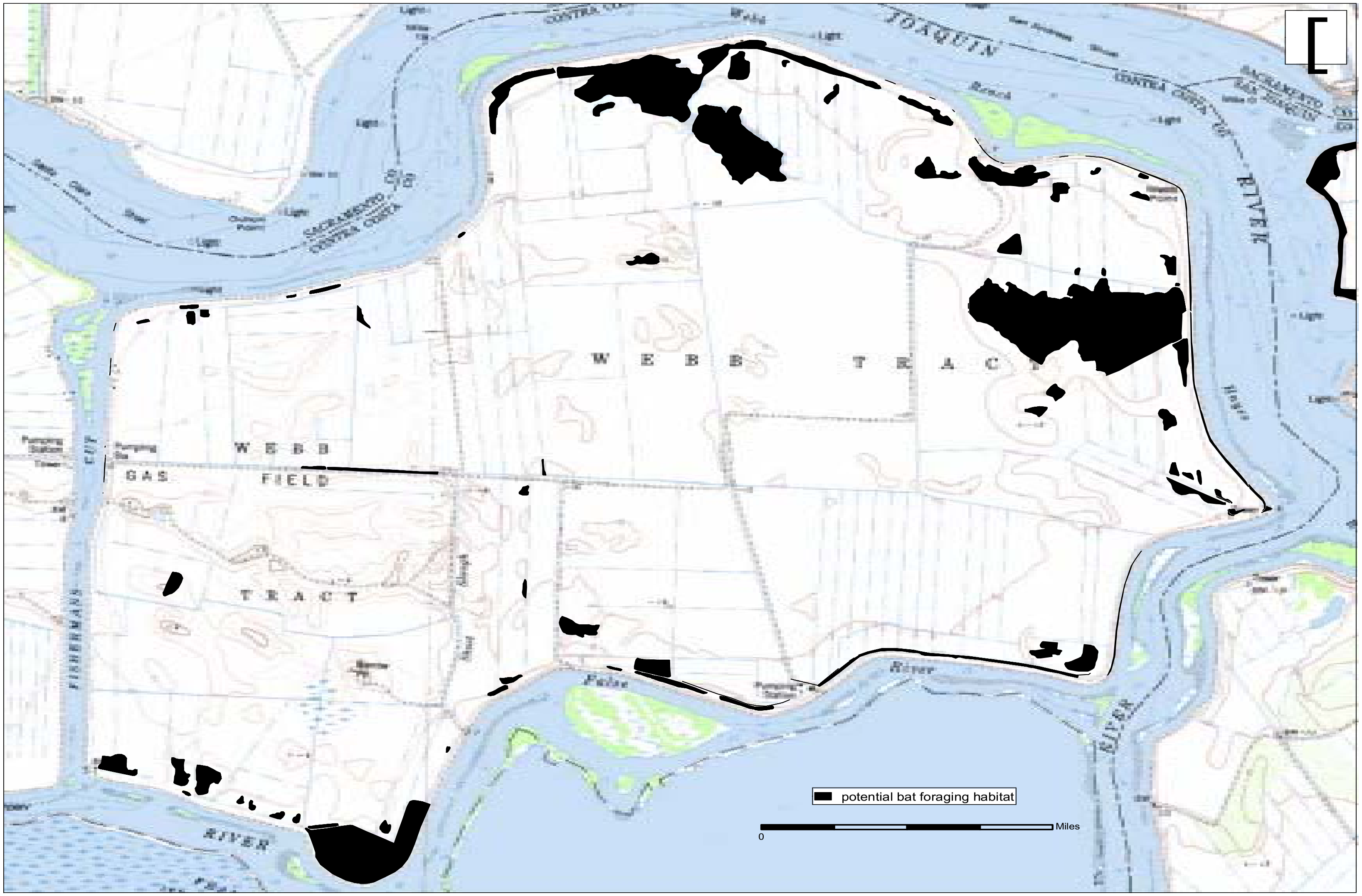
Webb Tract was surveyed on June 10th and August 6th, 2002. Potential roosting and foraging habitat is available on the island, but bat presence was not confirmed. No roosting sites were found during structural inspections. Island access limitations precluded the foraging activity surveys after sunset.

On Webb Tract, the principal roosting and foraging habitat components are riparian and mixed woodland habitat surrounding the two lake features (Figures 5-20 and 5-21). The woodlands are composed primarily of mature willow trees (*Salix* sp.) with a few scattered cottonwood trees (*Populus* sp.) and a shrub understory. Suitable roosting habitat is available in crevices and cavities in the thick bark and open structure of the trees. A few snags with exfoliating bark that bats may roost under were present. No tree hollows were observed during a cursory inspection near the access road.

The overall structure of the woodland habitat is complex, yet open and suitable for foraging. Bats tend to forage by following treelines and circling open areas such as those found in this woodland (Figure 5-22). An abundance of insects and foraging swallows were observed. Swallows are aerial insectivores that roost and forage in habitat similar to that of bats; their presence is indicative of the habitat quality. The lake features appear suitable for drinking and foraging.



WEBB TRACT
WEBB GAS FIELD
TRACT
SACRAMENTO
CONTRA COSTA
RIVER
Reach
False
River
FISHERMANS CUT
potential bat roosting habitat
potential bat roosting points (structures)
0
1
2
Miles



potential bat foraging habitat
0
Miles
WEBB TRACT
WEBB GAS FIELD
TRACT
JOAQUIN
RIVER
False River
FISHERMANS CUT
SACRAMENTO
CONTRA COSTA

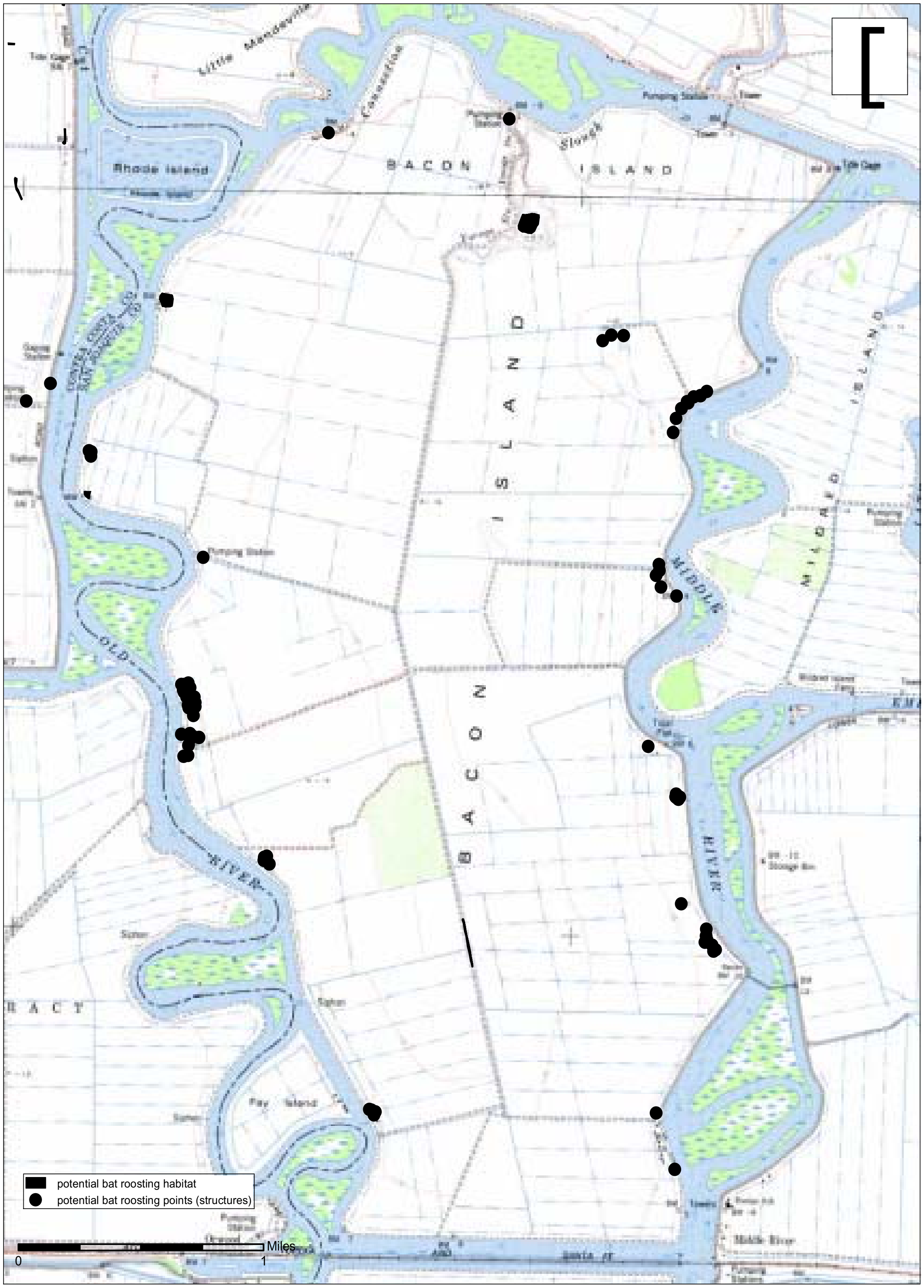
Figure 5-22. Potential roosting and foraging woodland habitat adjacent to a water feature on Webb Tract

Potential roosting habitat was also identified in various structures, which included barns, sheds, warehouses, machinery housings, louvered pump housings, irrigation pipe wooden pole supports, footbridges, a quonset hut warehouse, and an abandoned house. No signs of bat occupancy were found. Swallow nests were ubiquitous in these structures.

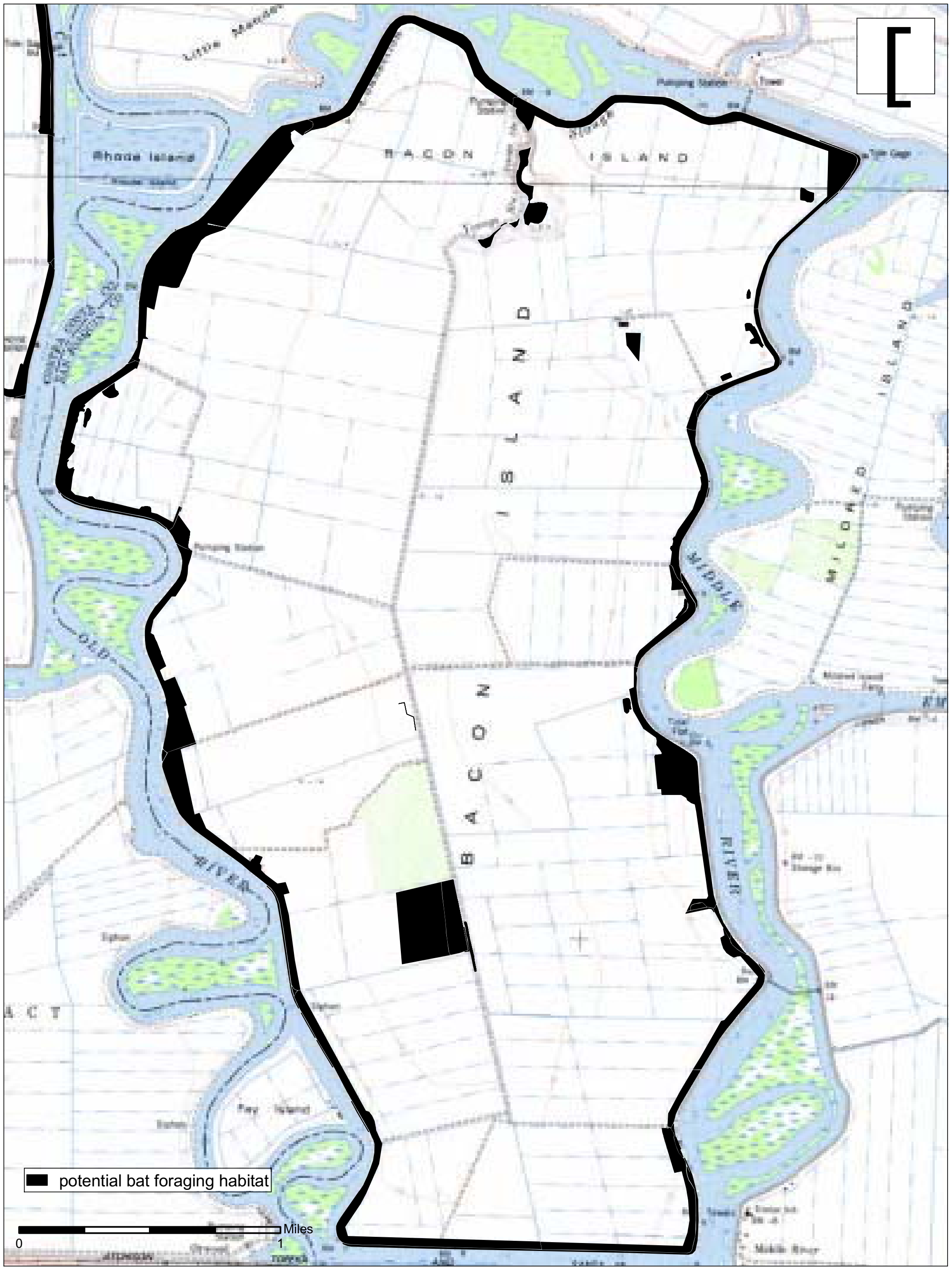
Bacon Island

Bacon Island was surveyed on June 13th and 20th, and August 7th and 8th, 2002. Night surveys were conducted on August 7th and 8th during warm, calm weather. Bats are using various habitat components for foraging and activity was detected in several areas. The bats were not detected until about 40 minutes after sunset, which indicates that they are roosting off the island. Potential roosting habitat is available on the island in vegetation and in numerous structures, which included abandoned homes and sheds, barns, warehouses, and pump housings (Figure 5-23). However no roosting sites were found during structural inspections. Swallow nests and barn owl roosts were found in the structures.

The principal habitat components on Bacon Island are foraging areas that include patches of riparian habitat, irrigation canals, and areas where insects are attracted to lights (Figure 5-24). Low activity by foraging bats was detected at a patch of riparian habitat (Figure 5-25) and along the adjacent irrigation canal where a tree and other



potential bat roosting habitat
potential bat roosting points (structures)
Miles
0
1
BACON ISLAND
BACON ISLAND
Rhode Island
Little Mandeville
Connection Slough
OLD RIVER
MIDDLE RIVER
MILDRED ISLAND
Pumping Station
Fay Island



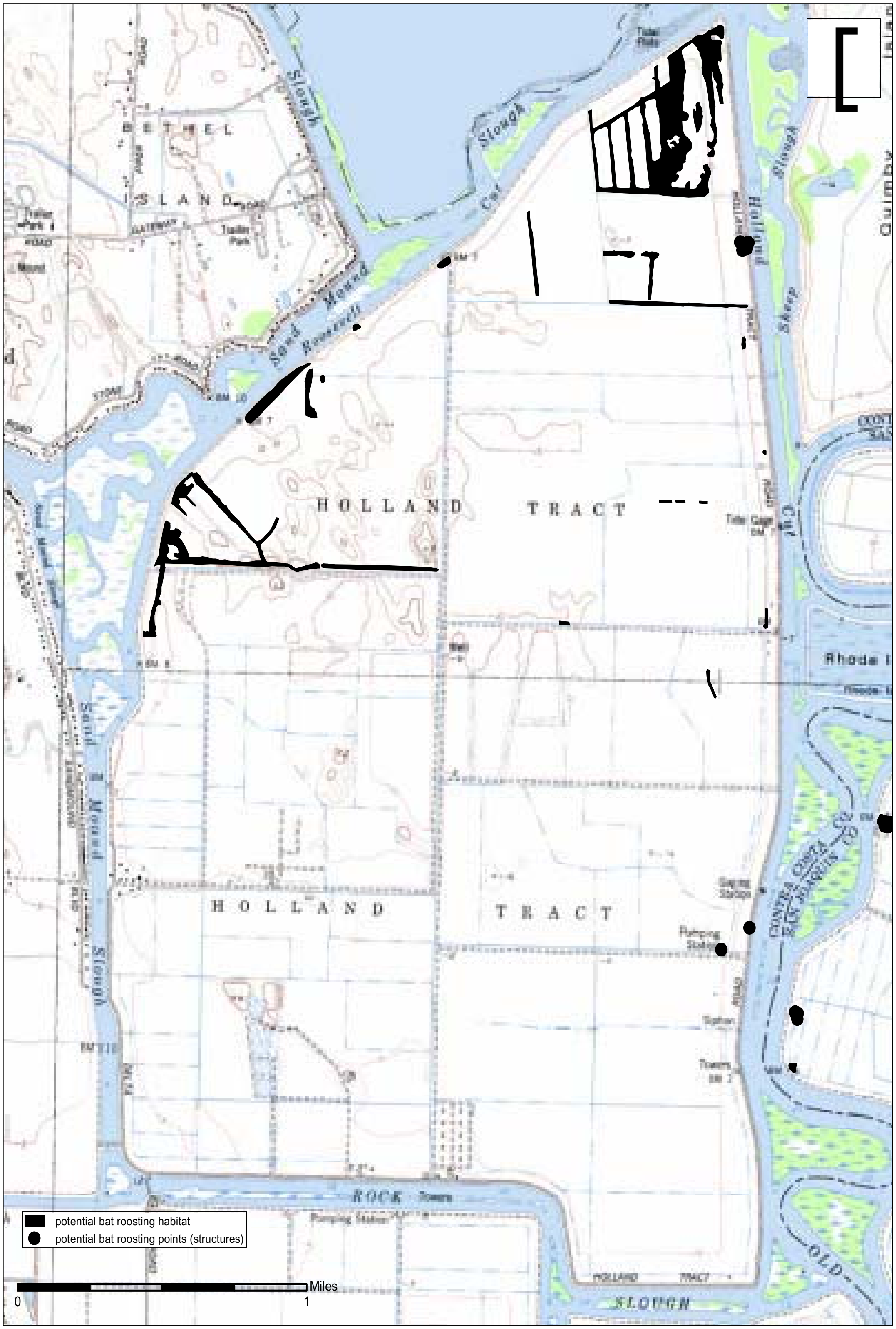
potential bat foraging habitat
0
1
Miles
BACON ISLAND
Rhode Island
OLD RIVER
MIDDLE RIVER
MILDRED ISLAND
Pumping Station
Siphon
Pumping Station
Tower

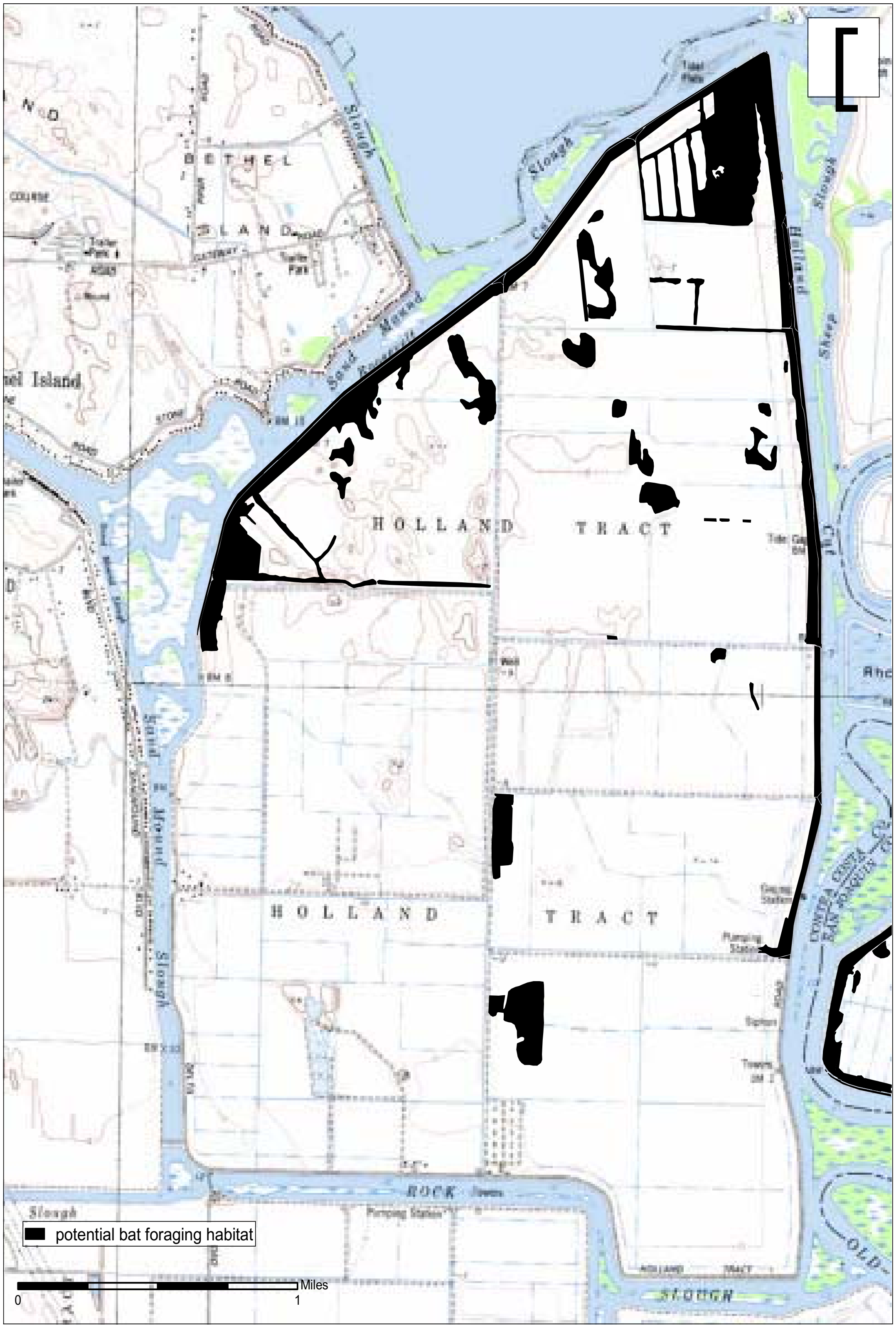
vegetation lined the banks. These two features were remarkably small and isolated and their importance was demonstrated by the presence of the bats. Bats were detected foraging along the canal in another area where vegetation lined the banks near a pump house. High activity by foraging bats was monitored near a mercury vapor light on an outbuilding in the Kyser Farms compound. Copious numbers of insects including crickets, grasshoppers, water beetles, preying mantis, and leaf hoppers were attracted to the light. Mexican free-tailed bats (*Tadarida brasiliensis*) were recorded and spotlighted as they took advantage of the insect swarms. It was not possible to estimate the number of bats observed because individuals cannot be visually tracked as they enter and exit the space illuminated by the spotlight. A resident reported that bats are also attracted to lights near his home.

Figure 5-25. Isolated patch of riparian habitat used by foraging bats on Bacon Island

Holland Tract

Holland Tract was surveyed on June 17th and August 9th, 2002. Night surveys were conducted on both nights in suitable weather conditions. Potential roosting habitat is available, however no roosting sites were found during structural inspections (Figure 5-26). The use of foraging habitat was confirmed in several locations (Figure 5-27). Habitat components on Holland Tract that are utilized by bats include structurally complex interfaces where vegetation is diverse (i.e., with trees, shrubs, and grasslands) and riparian and mixed woodland habitat associated with large lakes. Two particular


potential bat roosting habitat
potential bat roosting points (structures)
0
1
Miles
BETHEL
ISLAND
HOLLAND TRACT
HOLLAND TRACT
Sand Mound Slough
ROCK SLOUGH
Rhode Island
CONTRA COSTA CO
SAN JOAQUIN CO
OLD
Pumping Station
Trailer Park
Holland Cut



BETHEL
ISLAND
HOLLAND TRACT
HOLLAND TRACT
Sand Mound Slough
Holland Cut
Sheep Slough
ROCK Slough
OLD
SLOUGH
Pumping Station
Tide Gage
Gaging Station
Siphon
Towers
potential bat foraging habitat
0
1
Miles

areas along the northwestern border featured complex structures for foraging, with open fields, shrubs, and tree lines. Foraging bats were detected in this habitat on June 17th .

The large water features are suitable for drinking and foraging for bats (Figure 5-28). Mexican free-tailed bats and western pipistrelles (*Pipistrellus hesperus*) were detected over the lake on August 9th (based on analysis of echolocation calls). The surrounding woodland vegetation included mature willow trees and scattered cottonwoods which may be suitable for roosting habitat. Trees were not closely inspected however their mature structure and thick bark appeared to offer suitable crevices and cavities. A few snags were present with exfoliating bark that bats may roost under. Unidentified bats were observed executing repeated foraging passes along treelines in the woodland about 20 minutes after sunset on August 9th.

Figure 5-28. Riparian and mixed woodland vegetation associated with a lake where foraging bats were detected on Holland Tract

Potential roosting habitat was also available in various structures, which included a factory building, abandoned homes and sheds, warehouses, machinery housings, and louvered pump housings. No signs of bat occupancy were found. Swallows were observed foraging on insects over the lake, woodland, and crops, and nesting in the abandoned structures.

Bouldin Island

Bouldin Island was surveyed on June 21st and August 5th, 2002. Potential roosting and foraging habitat is available on the island but may not be utilized. No roost sites were found and no bats were detected during the single night survey on August 5th. A worker reported seeing bats flying near a small group of mature cottonwoods in the extreme southwestern corner of the island.

Potential roosting habitat components on Bouldin Island were limited and included a few abandoned buildings and a few small stands of large, mature cottonwoods (Figure 5-29). Trees were not inspected for bats, however hollows, broken limbs, and thick bark may offer suitable crevices and cavities. A bridge along State Route (SR) 12 at the west end of the island appeared to be suitable for bat occupancy but had no sign. Expansion joints along the causeway sections of SR 12 had open crevices but no bats were observed. Pump housings were the only additional roosting habitat available. According to a farm worker, a barn with bats in it had been present in the past but had since burned down.

Potential foraging habitat components included wetland, cropland and fallow fields (Figure 5-30). Mature willow trees and willow shrubs were also present. No bats were detected during an acoustic survey at the wetlands near the middle of the island. The weather on the survey night was warm but windy and may have affected bat foraging behavior. Swallows were observed foraging over the island and indicate suitable habitat for aerial insectivores.

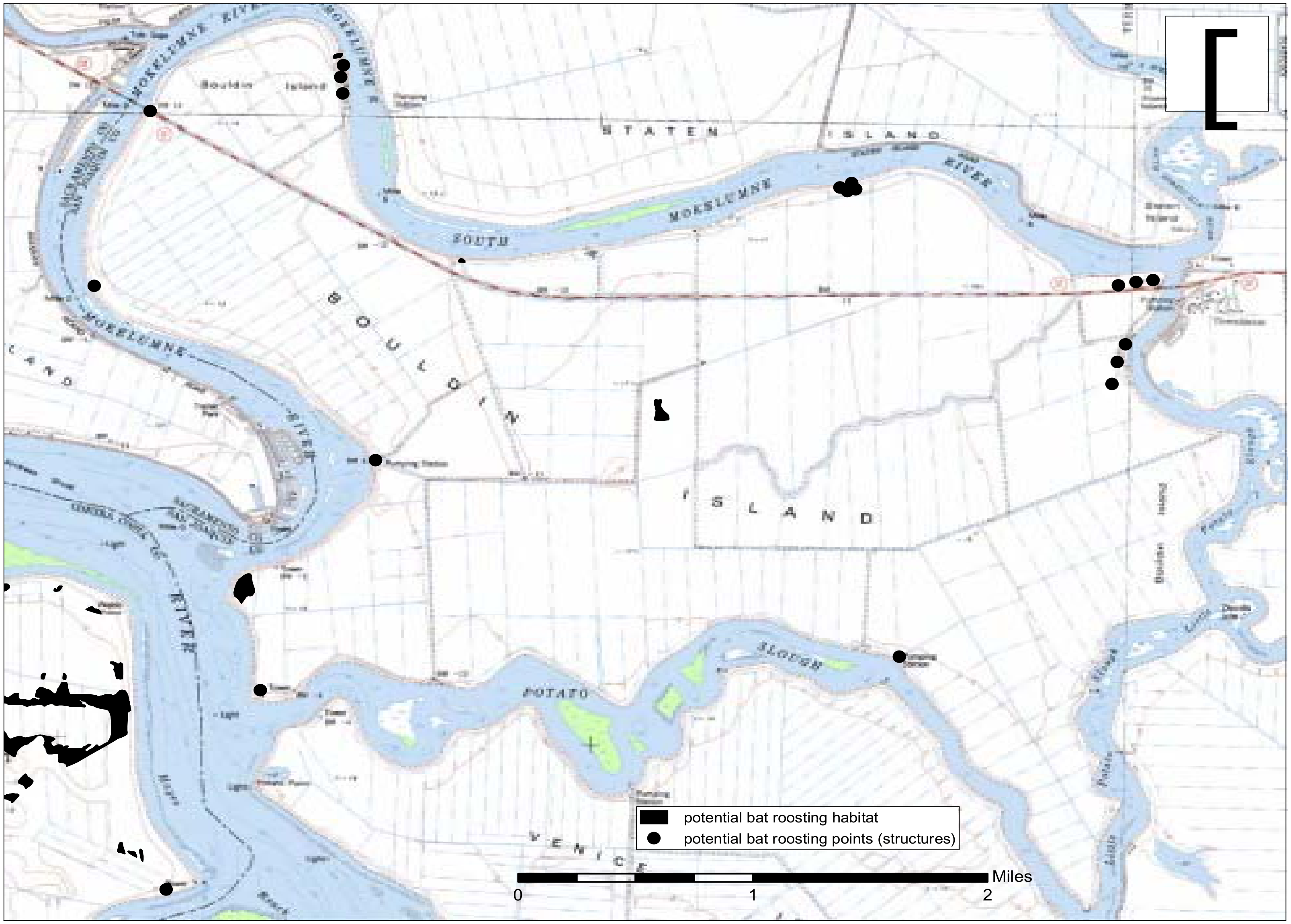
Discussion

Specific Bat Species

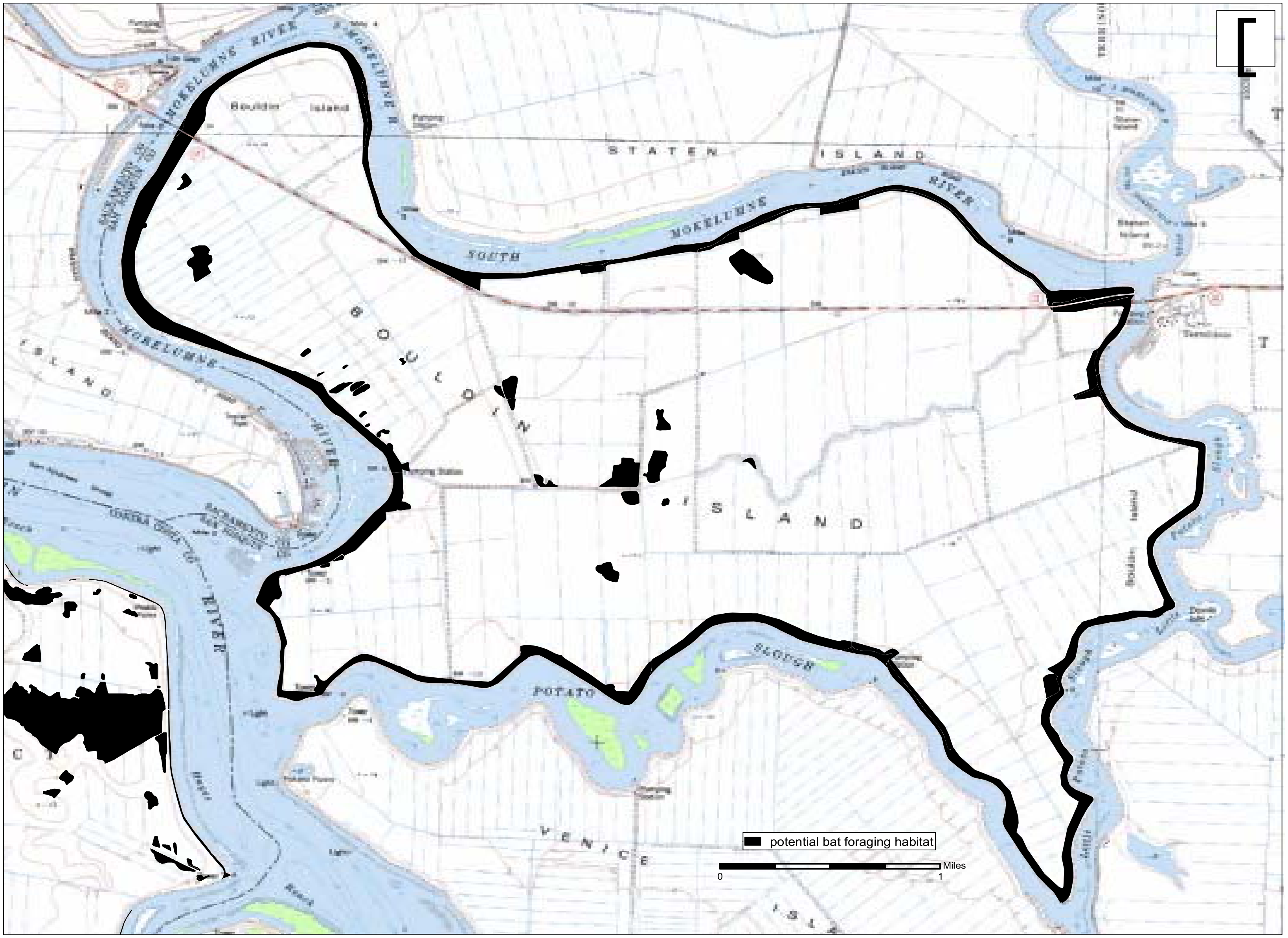
Based on the results of the habitat assessment and preliminary surveys of the Delta islands, these surveys were insufficient to fully address habitat suitability for the Townsend’s big-eared bat, pallid bat, red bat, small-footed myotis, and Yuma myotis. The Townsend’s big-eared bat and pallid bat are unlikely to be roosting on any of the islands but they may forage in the project area. Potential habitat for the red bat, Yuma myotis, and small-footed myotis is present and additional surveys would be necessary to address suitability. Potentially suitable habitat for other special-status bat species was not observed.

No suitable roosting habitat for the Townsend’s big-eared bat was observed on any of the islands. Cave-like barns may be the only features on the islands that would be suitable, and of those surveyed none contained sign of occupancy. Potential insect prey for the Townsend’s big-eared bat (e.g., butterflies and moths) was observed on all of the islands.

Potential roosting habitat for the pallid bat exists on all of the islands in hollow trees and structures. Potential insect prey for the pallid bat (e.g., beetles, grasshoppers, and crickets) was observed on each island. Pallid bats often roost in order to consume these larger prey items and the sign of this species’ presence are roost sites where discarded pieces of the insects and recognizable guano are found. No pallid bat sign was observed. However, the development of mature riparian woodland and structurally



BOULDIN
ISLAND
STATEN ISLAND
SOUTH MOKELUMNE RIVER
MOKELUMNE RIVER
POTATO SLOUGH
VENICE
Bouldin Island
Pumping Station
potential bat roosting habitat
potential bat roosting points (structures)
0
1
2
Miles



potential bat foraging habitat
0
1
Miles
STATEN ISLAND
BOULDIN ISLAND
Bouldin Island
SOUTH MOKELUMNE RIVER
MOKELUMNE RIVER
POTATO SLOUGH
VENICE
RIVER

complex vegetation interface habitats on Bouldin Island would provide forage habitat for pallid bats (Figure 5-31).

The riparian habitat on Webb Tract and Holland Tract may be potentially suitable for the western red bat. Red bats roost in foliage, usually riparian vegetation and cottonwoods and sycamores are most often mentioned as suitable tree species. The suitability of woodlands dominated by willows requires further investigation using acoustic monitoring to survey for red bat echolocation calls. Capture surveys would also be appropriate to verify presence if suitable netting sites are available. A combination of these techniques is the best survey method.

Potential foraging habitat for the Yuma myotis exists in the project area, especially over open water in lakes, ponds, and irrigation canals. This species often roosts in structures near water and no roost sites were observed on the islands.

Potential foraging habitat for the small-footed myotis exists in the project area, especially in riparian habitat and areas where treelines, shrubs, and grasslands form complex vegetation interfaces. This species often roosts in cliffs and rock formations and these specific roost types were not observed. The small-footed myotis will also roost in structures.

Roosting Habitat

Bats share similar cavity and crevice habitat preferences with swallows, owls, bees and wasps, which were common in the abandoned structures on the islands. The absence of roosting bats in abandoned structures was remarkable since they appeared to be suitable. Therefore, roosting habitat is not expected to be lost by building removal on Webb Tract and Bacon Island, however roosting habitat may be lost by flooding vegetation. The woodlands around the lakes on Webb Tract are the most likely area to be impacted by flooding.

A summary of impacts and survey recommendations are included in Table 5-14.

Webb Tract

Habitat was assessed on Webb Tract but surveys were limited because of access restrictions that precluded acoustic sampling of foraging activity after sunset. Acoustic surveys would be required to characterize foraging activity and, if bats are detected at or soon after sunset, then roosting in the woodland is likely. Flooding of Webb Tract will probably result in a significant loss of bat foraging habitat, and possibly roosting habitat. If DWR assumes that foraging and roosting occurs on Webb Tract, mitigation in kind for the habitat loss should be sufficient. Restoration and/or development of lakes and mature woodlands on Holland Tract and Bouldin Island could mitigate for the habitat loss.

Bacon Island

Flooding and building removal will result in a loss of bat foraging habitat on Bacon Island. Webb Tract and Bacon Island will become large open water reservoirs each with about 5,400 acres of surface water (when full) with no vegetation in an area known for strong wind. The water will be subject to wind and wave action that is not conducive to flying and echolocation by bats. Bat activity tends to be concentrated over calm freshwater (Zimmerman and Glanz, 2000). Project operations are not predictable, and, therefore, abrupt changes in water depth and surface area could occur (CALFED Bay-Delta Program, 2002) with an unknown effect on insect prey production.

Table 5-14. Summary Of Impacts And Survey Recommendations For The In-Delta Storage Program Bat Habitat Assessment

Delta Island	Suitable Habitat Present?	Flooding/Structure Removal Impacts	Habitat Island Impacts	Specific Surveys Recommended?
Webb Tract	Yes (not confirmed)	Assume flooding will result in foraging and roosting habitat loss Structure removal no impact	Not applicable	Yes: acoustic and possibly capture for each species
Bacon Island	Yes: foraging	Flooding will result in foraging habitat loss Structure removal (building lights) will result in foraging habitat loss, no roosting habitat loss	Not applicable	Probably not necessary
Holland Tract	Yes: foraging and possibly roosting	Not applicable	Expanding complex vegetation interfaces, creating water features will increase potential bat habitat	Yes: acoustic and possibly capture for each species
Bouldin Island	Unknown (possibly not)	Not applicable	Creating complex vegetation interfaces, expanding and creating water features will increase potential bat habitat	No

Some species of bats have been observed to avoid open air areas (such as would be available over the reservoirs) possibly due to problems with orientation, lack of protection from wind, lack of protection from predators, low insect abundance (Ciechanowski and Zajac, 2002), and lower foraging success (de Jong, 1994). Bats and the insects they prey on avoid wind and cooler temperatures such as would occur over open water. Bats are most likely to forage in sheltered areas rather than exposed areas (Vaughan *et al.*, 1997). Prey density is usually higher in habitats with vegetation (Kalcounis and Brigham, 1995).

The habitat loss could be mitigated by restoration / development of suitable features on the habitat islands. Mitigation in kind should be sufficient.

Holland Tract

Expansion of habitats in which foraging bats were detected, such as mature riparian woodland and structurally complex vegetation interface habitats (Figure 5-31), would potentially increase bat foraging habitat.

Figure 5-31. Vegetation interface with tree lines, shrubs, and grassland where foraging bats were detected on Holland Tract

Bouldin Island

Bouldin Island is limited in potential roosting and foraging habitat for bats. Developing habitat features such as ponds, lakes, irrigation canals, riparian woodlands, and areas where treelines, shrubs, and grassland interface may increase habitat use by bats. Expanding and deepening the ponds in the center of Bouldin to minimize emergent vegetation and retain open water may increase bat habitat. Larger, more open waterways with vegetation on the margins could be created similar to those on Holland Tract (Figure 5-32) to increase foraging habitat.

Figure 5-32. Irrigation canal lined with vegetation on Holland Tract as an example of habitat to develop on Bouldin Island

Summary

Habitat assessment and preliminary surveys are insufficient to fully address suitability of each island habitat for the five bat species identified by DWR. It is unlikely that the Townsend's big-eared bat and pallid bat are roosting on any of the islands but they may forage in the project area. Additional surveys would be necessary to address presence of the red bat, Yuma myotis, and small-footed myotis. No published bat studies conducted in or near the Delta are currently known.

Potential roosting habitat in structures is present on each of the islands but does not appear to be utilized. Therefore roosting habitat is not expected to be lost by building removal on the reservoir islands, however roosting habitat may be lost by flooding vegetation. Foraging habitat was confirmed on Bacon Island and Holland Tract near water features, riparian woodlands, and areas with complex vegetation structures. Webb Tract was not surveyed for foraging bats but it is recommended that the existence of bat habitat be assumed. No foraging bats were detected on Bouldin Island but the survey may have been insufficient due to inclement weather.

APPENDIX A. LIST OF WILDLIFE SPECIES OBSERVED DURING SURVEYS CONDUCTED FOR THE IN-DELTA STORAGE PROGRAM

Common Name	Scientific Name	Delta Island Observed	Comments
Western pond turtle	*Clemmys marmorata*	Holland Tract	Two locations SE corner California Species of Special Concern
Swainson's hawk	*Buteo swainsoni*	Webb Tract, Bacon Island, Holland Tract	Pair on Bacon Island California Threatened
White-tailed kite	*Elanus leucurus*	Bouldin Island	
Red-tailed hawk	*Buteo jamaicensis*	Holland Tract	Pair
Northern harrier	*Circus cyaneus*	Holland Tract	
Barn owl	*Tyto alba*	Webb Tract, Bacon Island, Holland Tract	
Great-horned owl	*Bubo virginianus*	Bouldin Island	Pair in grove NE corner
Cliff swallow	*Hirundo pyrrhonata*	Webb Tract, Bacon Island, Holland Tract	
Barn swallow	*Hirundo rustica*	Webb Tract, Bacon Island, Holland Tract	
Unid. herons		Holland Tact	Communal roost by lake
Mexican free-tailed bat	*Tadarida brasiliensis*	Bacon Island, Holland Tract	
Western pipistrelle	*Pipistrellus hesperus*	Holland Tract	
River otter	*Lutra canadensis*	Webb Tract, Bouldin Island	

Appendix D. Wetland and Giant Garter Snake Off-Site Mitigation Options for the In-Delta Storage Project Feasibility Investigation

Technical Memorandum

Wetland and Giant Garter Snake Off-Site Mitigation Options for the In-Delta Storage Project Feasibility Investigation

Prepared for

Department of Water Resources

April 2003

CH2MHILL
2485 Natomas Park Drive, Suite 600
Sacramento, CA 95833-2937

Wetland and Giant Garter Snake (*Thamnophis gigas*) Off-site Mitigation Options for the In-Delta Storage Project Feasibility Investigation

PREPARED FOR: Leslie Pierce, Senior Environmental Scientist, California Department of Water Resources

PREPARED BY: Dick Daniel, Project Manager, CH2M HILL

COPIES: Meri Miles, Project Scientist, CH2M HILL

DATE: April 28, 2003

Introduction and Background

This memorandum documents our assessment of off-site mitigation options for jurisdictional wetlands and the federally threatened giant garter snake (*Thamnophis gigas*), that could be adversely affected by the proposed In-Delta Storage Project (Project) if giant garter snakes are present on the impact islands. The Project would involve flooding Bacon Island and Webb Tract in the Sacramento-San Joaquin Delta for use as water storage facilities. The California Department of Water Resources (Department) is the state lead agency for this project. Costs associated with environmental mitigation will be used by the Department in assessing the feasibility of adding the Project as a new facility to the State Water Project (SWP) and / or the Central Valley Project (CVP).

Delta Wetlands Properties (Delta Wetlands) is a private-sector company that developed the Delta Wetlands Project, the project on which the In-Delta Storage Project is based. Delta Wetlands received a Clean Water Act, Section 404 dredge and fill permit for the Delta Wetlands Project on June 26, 2002, by the U.S. Army Corps of Engineers (Corps), Sacramento District. Terms of the permit included habitat compensation requirements for impacts to jurisdictional wetlands on Bacon Island, Webb Tract, Bouldin Island and Holland Tract. In 1997, an Incidental Take Statement was issued by the U.S. Fish and Wildlife Service (Service) for take of federally protected species associated with the Delta Wetlands Project. At that time, the giant garter snake was not considered present on the impact islands and was therefore not covered in the Incidental Take Statement. In April 2002, one giant garter snake was observed on Webb Tract. For the purposes of the State's feasibility study, the Department will assume that the giant garter snake is present on the Project islands.

Compensation Requirements for Jurisdictional Wetlands and Giant Garter Snake Habitat

Jurisdictional wetland compensation requirements for Bacon Island and Webb Tract in the Corps' Section 404 permit include: 1) 300 acres of cottonwood / willow woodland; 2) 132 acres of Great Valley willow scrub; 3) 85 acres of permanent pond; and 4) 345 acres of freshwater marsh. Boulder Island and Holland Tract were included in the Delta wetlands permit; however, under the current project, no impacts to jurisdictional wetlands on these islands are anticipated.

Giant garter snake compensation requirements are based on replacement of high and moderate quality giant garter snake habitat at a 3:1 replacement ratio (e.g., for every one acre impacted, three acres must be created) and a roughly 2:1 upland to aquatic ratio. These compensation requirements were established by Ryan Olah and Craig Aubrey of the U.S. Fish and Wildlife Service (Service) on February 5, 2003, during a meeting with the Department to discuss the Project. The extent and value of giant garter snake habitat that would be adversely affected by the Project were calculated based on the results of August and September 2002 habitat surveys conducted by Laura Patterson of the Department and Eric Hansen, a Consulting Herpetologist specializing in the giant garter snake. Based on the survey results, 3,345 acres of compensatory habitat would be required to mitigate the loss of giant garter snake habitat. Of that total, approximately 1,115 acres are necessary as aquatic habitat, and 2,230 acres are necessary as upland habitat.

On April 3, 2003, Leslie Pierce of the Department spoke with Mike Finan of the Corps' Regulatory Program in the Sacramento District. In this conversation, Mr. Finan said the Corps would allow the wetland mitigation to be counted toward meeting the aquatic habitat component of the giant garter snake mitigation as long as both the species needs and wetland requirements were met (pers. comm. Leslie Pierce, Department of Water Resources, April 3, 2003). Jurisdictional wetland habitats considered suitable for the aquatic component of giant garter snake mitigation include 85 acres of permanent pond and 345 acres of freshwater marsh, for a total of 430 acres. Jurisdictional wetland habitats considered suitable for meeting the upland component of giant garter snake mitigation include 300 acres of cottonwood / willow woodland and 132 acres of Great Valley willow scrub. For purposes of this cost analysis, only jurisdictional wetlands associated with the aquatic component of giant garter snake habitat are applied toward meeting the species' mitigation acreage requirement. This is because herbaceous upland, not riparian, comprises the "upland" component of existing giant garter snake banks and is reflected in the price per credit. Riparian habitat (e.g., cottonwood / willow) is considerably more costly to create than herbaceous upland, and would inflate the credit price for giant garter snake mitigation beyond the current market value at existing banks. Our mitigation cost projections for the Project are based on existing market values, and the use of riparian habitat to meet the upland component of the giant garter snake mitigation would distort the analysis.

Table 1 is a summary of the combined compensatory mitigation required for impacts to jurisdictional wetlands to giant garter snake habitat resulting from the Project.

TABLE 1
Jurisdictional Wetland and Giant Garter Snake Habitat Compensation Requirements

<table>
<tr><th>Habitat Type</th><th>Jurisdictional Wetland Compensation (acres)</th><th>Giant Garter Snake Compensation (acres)</th></tr>
<tr><td>Cottonwood/willow woodland</td><td>300</td><td></td></tr>
<tr><td>Great Valley willow scrub</td><td>132</td><td></td></tr>
<tr><td>Emergent marsh</td><td>0
(345 accounted for in the giant garter snake mitigation)</td><td rowspan="2">1,115</td></tr>
<tr><td>Permanent pond</td><td>0
(85 accounted for in the giant garter snake mitigation)</td></tr>
<tr><td>Herbaceous upland</td><td></td><td>2,230</td></tr>
</table>

Off-site Mitigation Options for Wetland and Giant Garter Snake Mitigation

The Department's preferred approach for off-site mitigation is to purchase giant garter snake and wetland mitigation credits at an existing mitigation bank approved to service the Project area (pers. comm. Leslie Pierce, Department of Water Resources, March 2003). Wildlands, Inc. is the only company in the Sacramento Valley / Sacramento-San Joaquin Delta region that has publicly available mitigation credits for purchase. On April 2, 2003, Meri Miles from CH2M HILL and Leslie Pierce from the Department met with Kellie Berry, the Sales and Marketing Director for Wildlands, Inc. The purpose of this meeting was to discuss the Department's mitigation needs for the Project, identify existing mitigation banks with potential to service the Project, and discuss the approximate cost per mitigation credit. Ms. Berry cautioned that Wildlands, Inc. mitigation costs are subject to change and that cost information provided by Wildlands, Inc. may be appropriate for planning purposes, but should not be used for detailed costing related to project implementation. Use of the costs of Wildlands, Inc. mitigation credits in the Feasibility Report does not imply a commitment by the Department to purchase credits from Wildlands, Inc. if the Project proceeds.

Giant Garter Snake Mitigation Banks

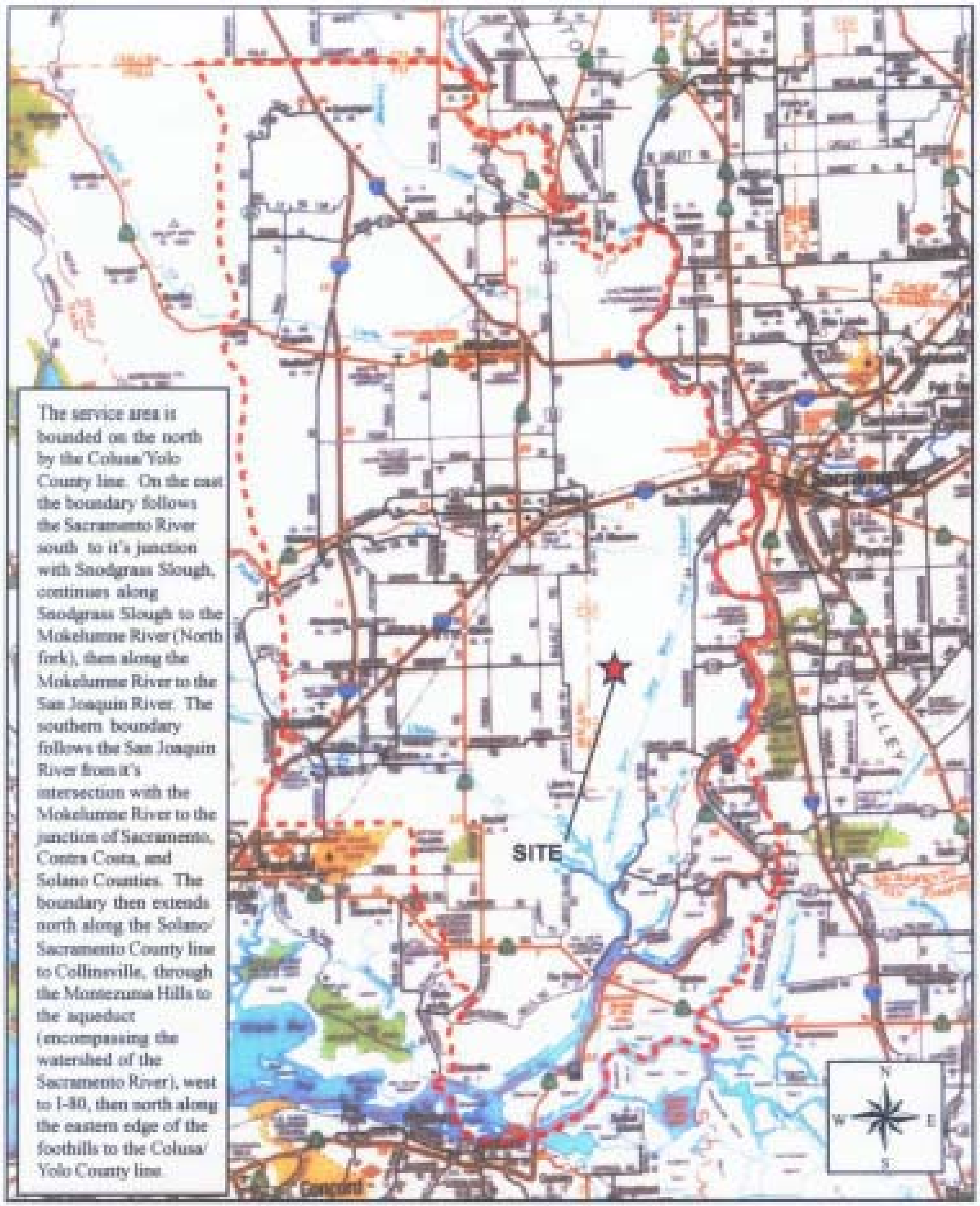
Pope Ranch is a 391-acre bank in Yolo County whose service area boundary extends south to Webb Tract in the Sacramento-San Joaquin Delta. Figure 1 illustrates the service area for the Pope Ranch Conservation Bank. In the February 5, 2003 meeting with the Service and Department of Fish and Game, Service staff indicated that Pope Ranch Conservation Bank could be used to mitigate giant garter snake impacts from the Project. Pope Ranch is the only bank approved to mitigate giant garter snake impacts in the Project area. Approximately 200 habitat credits are available at Pope Ranch. One credit is equivalent to one acre of high quality giant garter snake habitat, consisting of either emergent wetland, or channels with slow moving water and open water areas surrounded by at least 200 feet of upland. The Service's required 2:1 ratio of upland to aquatic habitat is built into each habitat credit. As a reflection of economy of scale, the cost per credit decreases with the number of credits purchased. Credit costs are subject to change, but the highest price per giant garter snake credit is currently $25,000 per acre. Significantly more credits are needed for the Project than Pope Ranch can provide. Ms. Berry explained that given the magnitude of compensatory habitat needed, a bank could be developed specifically for this Project. Alternatively, the Service manages a "Species Fund" for the giant garter snake in which permit applicants in need of giant garter snake mitigation can purchase mitigation credits at a cost of $37,500 per acre (Pers. Comm. Craig Aubrey, U.S. Fish and Wildlife Service, April 27, 2003). This option is typically made available for projects for which a mitigation bank is not available, and is not a mitigation method preferred by the Service (Pers. Comm. Craig Aubrey, U.S. Fish and Wildlife Service, April 27, 2003). It is presented here for the purposes of comparison to the open market cost of a giant garter snake mitigation bank credit, but the Species Fund would likely not be a viable mitigation option for the Project. Assuming a cost of $25,000 per acre, an estimated total cost for 3,345 acres of giant garter snake mitigation for the Project is $83,625,000.

Wetland Mitigation Banks

Compensatory habitat for freshwater emergent wetland and permanent pond was included in the giant garter snake mitigation; therefore, no additional mitigation for these wetland types is necessary. Compensation for the loss of cottonwood / willow woodland and Great Valley willow scrub on Bacon Island and Webb Tract is required to meet the conditions of the Section 404 permit issued for the Project. The Wildland Mitigation Bank in Placer County is the closest riparian mitigation bank to the Project area. This is a 616–acre bank owned and operated by Wildlands, Inc. The cost per riparian credit at this bank is currently $60,000 an acre. The Project area falls outside of the approved service area for the Wildland Bank, as shown in Figure 2. No banks are currently available to meet the 432-acre riparian compensation requirement in the Project's Section 404 permit. Ms. Berry suggested that a new bank could be developed in order to service both riparian and giant garter snake mitigation for the Project. Assuming a worst-case scenario of $60,000 per acre, an estimated total cost for 432 acres of riparian woodland mitigation for the Project is $25,920,000.

Summary and Conclusions

No mitigation banks are currently available to service the entirety of Project impacts to the giant garter snake and jurisdictional wetlands. Based on current market values in the Sacramento Valley region, the cost per giant garter snake credit is $25,000 per acre, and the cost of riparian woodland is $60,000 per acre. The Sacramento District Corps will allow mitigation for emergent wetland and permanent pond to be counted toward meeting the aquatic habitat component of the giant garter snake mitigation as long as both the species needs and wetland requirements are met. Under a worst-case scenario, Project mitigation costs for jurisdictional wetlands and the giant garter snake are approximately $109 Million. Given the magnitude of compensatory habitat required to meet giant garter snake and jurisdictional wetland mitigation requirements, development of a mitigation bank specifically for the In-Delta Storage Project, or exploring mitigation options on suitable properties already owned by the Department or U.S. Bureau of Reclamation may be warranted.



Wildlands, Inc.

Pope Ranch Conservation Bank Service Area
Giant Garter Snake Mitigation Credits

FIGURE 1
CH2MHILL

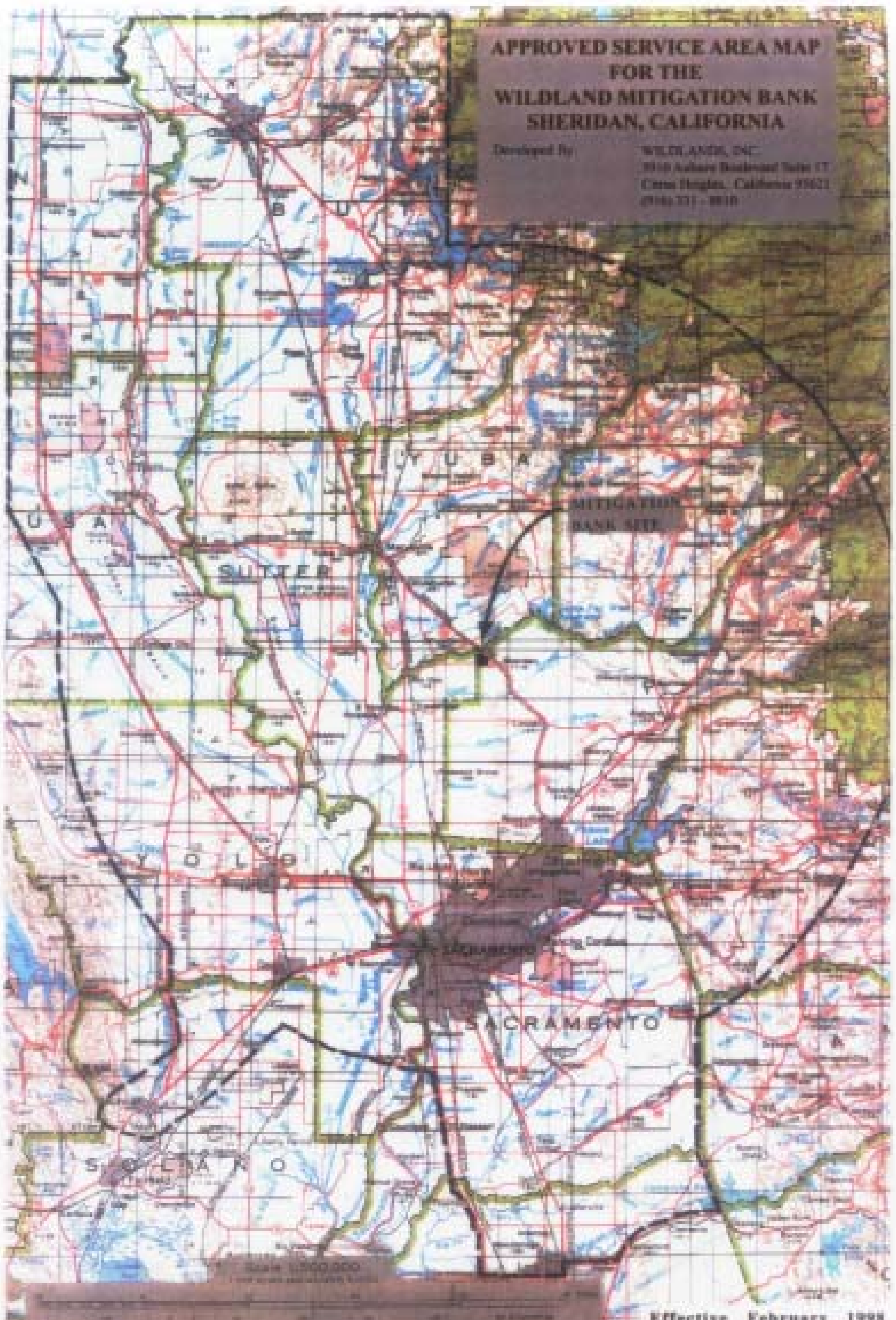


FIGURE 2
Service Area For The Wildland Mitigation Bank in Placer County, California

CH2MHILL

Appendix E. Phase II Environmental Site Assessment Draft Report, May 2003

DRAFT

For Discussion Purposes Only
REV: 05 / 16 / 03

State of California
The Resources Agency
Department of Water Resources
Division of Environmental Services
Site Assessment Section
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PHASE II ENVIRONMENTAL SITE ASSESSMENT

IN-DELTA STORAGE PROJECT

CONTRA COSTA & SAN JOAQUIN COUNTIES, CALIFORNIA

MAY 2003

GRAY DAVIS
Governor
State of California

MARY D. NICHOLS
Secretary for Resources
The Resources Agency

THOMAS M. HANNIGAN
Director
Department of Water Resources

DRAFT

For Discussion Purposes Only
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Department of Water Resources

FOREWORD

The Department of Water Resources' Site Assessment Section conducted a Phase II Environmental Site Assessment for CALFED's In-Delta Storage Project ("Project"). The proposed project site ("Site") consists of the following properties located in the Sacramento/San Joaquin Delta: Bacon Island, Bouldin Island, Holland Tract, and Webb Tract. This assessment is part of a comprehensive State feasibility study for CALFED's In-Delta Storage Program ("Program").

The purpose of this Phase II ESA is to evaluate the nature and extent of suspected hazardous substance contamination as identified in the modified Phase I ESA for the Site dated December 2001. This Phase II ESA was performed in accordance with standards prescribed in American Society for Testing and Materials Designation E 1903-97 and DWR guidelines. This study was requested and authorized by Leslie Pierce of DWR's Surface Storage Investigations Branch.

The modified Phase I ESA revealed signs of potential soil contamination throughout the Site. The majority of the suspected contamination appeared to be at vehicle and farm equipment maintenance facilities located on each of the aforementioned properties. To determine the nature of contamination, soil sampling was recommended.

In September 2002, SAS staff collected a total of 77 soil samples at the Site. High levels of petroleum hydrocarbons, such as oil and grease, were detected at the vehicle and farm equipment maintenance facilities, especially in areas around or near fuel and lubricating oil tanks. Low concentrations of other potential contaminants, such as heavy metals, chlorinated pesticides, and organic solvents were also detected on each property. However, in each instance, their levels never exceeded the Total Threshold Limit Concentrations as established in Title 22 of the California Code of Regulations.

Based on the results of the Phase II ESA sampling, SAS recommends further investigation of the identified "hot spot" areas to better delineate the extent of contamination. Further investigation may include more invasive subsurface soil sampling, surface water and groundwater sampling, and environmental fate studies for each of the contaminants of concern. SAS also recommends that any contaminated soil at or near water supply well sites be removed and properly disposed of, or remediated, depending on the extent of contamination.

Lastly, SAS recommends that all measures be taken to indemnify the State from any liability associated with future hazardous substance contamination or remedial actions associated with the natural gas wells that are present throughout the Site. At this time, these gas wells and the parcels on which they are situated may not be part of the land acquisition for the Project. Such measures may include establishing baseline soil and groundwater sampling data for the properties surrounding the gas wells or inserting indemnification clauses in each of the proposed purchase agreements.

For additional information, please contact Derrick J. Adachi, Chief of DWR's Site Assessment Section, at (916) 445-6449, or James Gleim, at (916) 445-6228.

Barbara McDonnell, Chief
Division of Environmental Services

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This report was prepared under the supervision of

Derrick J. Adachi ....Chief, Environmental Site Assessment Section

By

James Gleim...Environmental Scientist

Editorial and Review

Margaret Jones-Shull ....Office Technician

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase II Environmental Site Assessment, as defined by American Society of Testing and Materials Designation E 1903-97, is to, "…evaluate the recognized environmental conditions identified in the Phase I ESA for the purpose of providing sufficient information regarding the nature and extent of contamination to assist in making informed business decisions about the property; and where applicable, providing the level of knowledge necessary to satisfy the innocent purchaser defense under [the Comprehensive Environmental Response, Compensation and Liability Act.]"

The ASTM designation defines *recognized environmental conditions* as, "…the presence or likely presence of any hazardous substances or petroleum products on property under conditions that indicate an existing release, a past release, or material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws."

1.2 Scope of Services

This investigation has been conducted in accordance with industry-accepted ASTM, Designation E 1903-97 for Phase II ESA's.

DWR's investigation included the following tasks:

- Positive determination of potential soil contamination identified through the Phase I ESA process
- Review of existing information
- Soil sampling and analysis
- Quality assurance/quality control procedures

1.3 Limitations

Any level of assessment cannot determine that a property is free of all environmental impairments such as chemicals and toxic substances. DWR cannot offer a certification or guarantee the absence of these conditions on the Site. This assessment is based on the findings made during the Phase I ESA and Phase II ESA investigations.

Variations could exist beyond or between areas investigated for this assessment. Conditions reported or observed could change because of the migration of contaminants, changes in grade, rainfall variation, temperature, and/or other factors not apparent during this assessment.

This assessment was performed for the sole use of CALFED's In-Delta Storage Program. Any reliance or use of information contained herein by a third party is at such party's sole risk. Other parties who rely on information provided in this report are responsible for determining the adequacy of information provided by others.

The services performed by DWR have been conducted in a manner consistent with the level of care and skill by members of our profession currently practicing under similar conditions in the State of California. No other warranty, either expressed or implied, is made.

Regarding the usability and validity of data, the ASTM standard states, "…measurements and sampling data only represent the site conditions at the time of data collection. Therefore, the usability of data collected as part of a Phase II ESA may have a finite lifetime depending on the application and use being made of the data. An environmental professional should evaluate whether previously generated data are appropriate for any subsequent use beyond the original purpose for which it was collected." Therefore, for future use, it is recommended that any party wishing to rely on the data contained in this report should consult with either SAS staff or another qualified environmental professional.

2.0 SITE DESCRIPTION AND BACKGROUND

2.1 Legal Description

The Site consists of the following properties located approximately 10 miles west of Stockton in the Sacramento/San Joaquin Delta: Bacon Island, Bouldin Island, Holland Tract, and Webb Tract. Bacon and Bouldin Islands are in San Joaquin County, while Holland and Webb Tracts are in Contra Costa County, California. The Site is located on the following USGS 7.5 minute quadrangles: Bouldin Island, Isleton, Jersey Island, Terminous, and Woodward Island quadrangles. The total land area is approximately 21,048 acres. Site location maps are in Figures 1-4.

It should be noted that Victoria Island was originally part of the Site and included in modified Phase I ESA. However, the project proponents have since removed Victoria Island from the proposed Project. As a result, Victoria Island is not included as part of this Phase II ESA.

2.2 Site Description and Features

This is a general composite description of each Site property as observed during the site reconnaissance portion of the modified Phase I ESA performed on September 17-24, 2001 and the Phase II ESA sampling activities performed on September 5-10, 2002. A more detailed description of each property and its features is provided in the December 2001 modified Phase I ESA report.

2.2.1 Bacon Island

Bacon Island is primarily farmed agricultural land. All roads within the island are unpaved. Youngs Slu enters the island from the north. Numerous irrigation canals also intersect the island.

A variety of structures and facilities are on the island which are associated with the farming operations performed there. Four farm equipment maintenance and staging areas were present, as well as numerous single-family residences. An unpaved aircraft runway was present along the eastern perimeter of the island, approximately two miles north of the island access bridge. Three packing sheds and two trash piles were also observed on the island.

2.2.2 Bouldin Island

Bouldin Island is primarily farmed agricultural land. Sheep grazing is also occurring on the island. All roads within the island are unpaved with the exception of Highway 12 which bisects it. There are numerous irrigation canals transect the island as well.

A variety of structures and facilities are on the island which are associated with the farming operations performed there. A farm headquarters facility with out-structures is located on the eastern perimeter of the island, immediately south of the Terminous Bridge. Two radio towers were present in the southwest portion of the island. Three water pumping stations were also observed. Numerous single-family residences are present along the northern perimeter of the island.

2.2.3 Holland Tract

Holland Tract appears to be used for farming and cattle grazing. All roads within the tract are unpaved with the exception of Holland Tract Road along the southern border. Numerous irrigation canals and fences transect the tract. Approximately two square miles located in the southwest portion of this tract will not be included as part of the Site.

There are two marinas located along the southeastern corner of the tract. The marinas are accessible from the levee road, but are not within the scope of the Project. There are numerous structures and buildings, such as single-family residences, situated along the levee road that could impact the Project. Two areas along the east border appear to be used for the storage of idle farm machinery and equipment. A corral was observed in the center of the tract. Numerous 55-gallon drums and an aboveground storage tank were present on the adjacent property. The contents of these containers or vessels are unknown. Evidence of stained soils was observed in the vicinity of these drums.

2.2.4 Webb Tract

Webb Tract also appears to be is used for farming. All roads within the tract are unpaved. Access to the tract is only by ferry.

A farm headquarters facility with out-structures is located on the western border of the tract. Adjacent to the farm headquarters is a maintenance facility and storage area for farm equipment. A single-family residence was observed at the easternmost point of the tract. A hunting clubhouse was also observed adjacent to the residence. A pumping station was situated along the southern border, as was a natural gas well facility.

2.3 Modified Phase I ESA Results

The purpose of this Phase II ESA is to further investigate the recognized environmental conditions that were identified in the modified Phase I ESA report dated December 2001. Specifically, this Phase II ESA evaluates the nature and extent of suspected hazardous substance contamination at the Site.

The following section is a summary review of the conclusions and recommendations specified in the modified Phase I ESA report for the Site.

2.3.1 Bacon Island

The modified Phase I ESA revealed signs of potential soil contamination in areas on Bacon Island. Stained soils were observed at the following locations: two separate farm headquarters facilities and storage shed on the east, a farm headquarters facility on the northeast, an aircraft runway on the eastern perimeter, and a container storage area on the southeast corner of the island. It was recommended that further investigation of these areas be conducted to determine the nature and extent of contamination.

A number of single-family residences were found on the island. Based on the age of these structures, SAS staff concluded that lead-based paints and asbestos containing materials (ACM) were likely to be present. Invasive sampling and testing of suspect construction materials, such as floor tiles, and coated surfaces were recommended to determine the actual presence of these potentially toxic substances. If the presence of lead-based paint and/or ACM was confirmed, SAS staff recommended that a management or abatement plan be prepared and implemented.

Further investigation of the type of sewage system used by these residences was recommended. In addition, SAS staff recommended that any sewage system should be properly removed prior to any habitat restoration or surface water storage activities to prevent any releases of sewage material into the environment.

No water supply wells were identified from the environmental database search. However, due to the presence of single-family residences and farming operations on the island, the existence of non-reported private wells was highly probable. SAS staff recommended proper decommissioning of any well found to exist on Bacon Island that will not be used by DWR.

The modified Phase I ESA revealed soil staining and pools of product at three oil well facilities on the island. SAS staff concluded that the apparent discharges posed a potential risk for soil, surface water, and groundwater contamination. Two of those wells lie within the new Site boundaries on Section 4 (T22S, R19E). Further investigation at the oil well facilities was recommended to determine the nature and extent of the suspected contamination. Proper decommissioning and closure of these facilities was also recommended.

2.3.2 Bouldin Island

The modified Phase I ESA revealed areas of potential hazardous substance contamination at the farm headquarters facility located along Highway 12 in the center of the island. SAS staff recommended that the nature and extent of the suspected contamination be further investigated by collecting and analyzing soil samples around the large above ground fuel tanks and leaking 55-gallon drums that were present at the time of the site reconnaissance.

Three secured groundwater monitoring wells were observed along the north border of the island. Since wells could potentially serve as conduits for groundwater contamination, it was recommended that they be properly decommissioned in accordance with applicable State and local laws and regulations.

It was also recommended that a large trash pile along the north levee road be properly inventoried and disposed of. Such piles have historically contained an assortment of household garbage, used appliances, spent chemical products, and other solid waste materials. Careful assessment of the contents of the pile may be necessary in order to prevent an accidental release of a hazardous or toxic contaminant.

There was visible evidence that the contents of an unlabeled 6,000-gallon poly tank had been released into the soil. A drainage pond is located approximately 30 feet down gradient from the tank. It is unknown whether any of the contents had migrated into the pond. As a result, it was recommended that the contents of the tank and pond be assessed.

2.3.3 Holland Tract

The modified Phase I ESA revealed signs of potential soil contamination in areas on Holland Tract. Stained soils were observed at the following locations: an equipment storage shed at the southeast corner of the tract, a staging area on the east levee road, and a corral area in the center of the tract. It was recommended that further investigation of these areas be conducted to determine the nature and extent of contamination.

It was reported that the dilapidated single-family residence on the east levee road by the farm equipment staging area is a potential source of hazardous substance liability. Based on the age of the structure, SAS staff concluded that lead-based paints and asbestos containing materials were likely to be present. Invasive sampling and testing of suspect construction materials, such as floor tiles, and coated surfaces were recommended to determine the actual presence of these potentially toxic substances. If the presence of lead-based paint and/or ACM was confirmed, SAS staff recommended that a management or abatement plan be prepared and implemented.

Further investigation of the type of sewage system that may have existed at this structure was recommended. In addition, SAS staff recommended that any sewage system should be properly removed prior to any habitat restoration or surface water storage activities to prevent any releases of sewage material into the environment.

The modified Phase I ESA also revealed the presence of one water supply well in the center of the tract. Two water pumping stations were also identified, one at the northernmost tip of the tract, the other along the east border. In order to prevent the wells from potentially serving as conduits for groundwater contamination, SAS staff recommended proper decommissioning of any well that will not be used by DWR.

2.3.4 Webb Tract

SAS staff recommended that further investigation be conducted at the farm maintenance headquarters on the western side of the tract. The headquarters facility was identified as having numerous areas of possible contamination that warrant further investigation. Extensive soil staining was observed surrounding the 55-gallon drums and aboveground storage tanks on the northern side of the maintenance shed. The discolored soil surrounding farm equipment and stained soil under heavy equipment are indications that local housekeeping practices may have allowed release of farm chemicals including grease, oil, herbicides, pesticides, and fertilizers. The trash burning area could also be a source of heavy metals contamination. The Phase I ESA reported that, based on the age of the facility, the former worker living quarters adjacent to the maintenance shed may potentially contain lead and asbestos containing construction materials.

Further investigation of the fuel tanks along the south levee road was recommended. The tanks at the hunting clubhouse, water pumping station, and gas well facility all displayed evidence of spillage or leakage.

Since the monitoring wells on the island could potentially serve as a conduit for contaminants to reach groundwater, it was recommended that they be properly decommissioned and removed.

3.0 PHASE II ESA SAMPLING

After receiving the recommendations made in the modified Phase I ESA report, Leslie Pierce of DWR's Surface Storage Investigations Branch requested that Phase II sampling be performed in the aforementioned locations. Phase II soil sampling was performed on September 5-10, 2002 by SAS staff. Representative samples were collected in accordance with procedures specified in "Test Methods for Evaluating Solid Waste, 3rd edition, SW-846, U.S. EPA, September 1986." A thorough discussion of sampling procedures is provided in the Sampling Plan (see Appendix A). The Sampling Plan includes sampling objectives, rationale, and methods.

All samples were analyzed by Caltest Analytical Laboratory in Napa, California. Soil samples were analyzed for Title 22 metals (including Chrome VI), chlorinated pesticides, polychlorinated biphenyls, aromatic and total hydrocarbons (including BTEX), oil and grease, organophosphorus pesticides, and semi-volatile organic pesticides.

Note that only positive sample results are reported in the text of this report. In order to ease reporting and discussion, those soil samples which had no analyte detected in them were not listed in the tables in this section. See Appendix B for a summary compilation of sample results. Appendix C contains the original Caltest analytical results and chain of custody forms.

Photographs of sampling are contained in Appendix D. All photographs were taken by James Gleim.

3.1 Bacon Island Soil Samples

Authoritative soil samples were collected on Bacon Island at areas where heavily stained soils were observed. Specifically, samples were collected at the aircraft runway, numerous areas at both farm headquarters facilities on the eastern end of the island, and at the west side storage shed.

3.1.1 Aircraft Runway Sample Results

The runway is a roughly paved strip situated one and one-half miles north of the Bacon Island Bridge, near the east levee road (Photo 1). The runway is situated in an east-west direction. Stained soil was observed in the area south of an aboveground fuel tank. One sample was collected at 0.5 feet below ground surface towards the eastern end of the runway approximately 30 feet south of the fuel tank. Sample results are shown in Table 1.


Photo 1

TABLE 1

AIRCRAFT RUNWAY SAMPLE RESULTS (Bacon Island)		
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)
	TTLC* (mg/kg)	0.5' BGS** Sample # DWB-22a (30' south of fuel tank)
METALS:		
Arsenic	500	6
Barium	10,000	130
Chromium (total)	2,500	31
Cobalt	8,000	9
Copper	2,500	21
Lead	1,000	12
Mercury	20	0.03
Molybdenum	3,500	2
Nickel	2,000	39
Vanadium	2,400	47
Zinc	5,000	55
OTHERS:		
pH	Not Available	5.0
Oil and Grease (mg/kg)	Not Available	**10,200**

* **TTLC = Total Threshold Limit Concentration**
** BGS = Below Ground Surface

The soils sample collected at the runway detected high levels of oil and grease (highlighted in red) that may require remediation. No other elements or compounds were detected in the sample at levels that exceed the regulatory threshold value (if available).

3.1.2 North Farm Headquarters Sample Results: Waste Oil Drums

A farm operations headquarters is located approximately one mile southwest of the northeast corner of the island. Four unlabeled 55-gallon drums were observed in the northernmost storage shed (Photo 2). Stained soil was observed in the vicinity of the drums. Samples were collected south of the drums, on the opposite side of the wall visible in Photo 2. The wall does not touch the ground, therefore any spillage or leakage from the drums would also be detected there. Sample results are shown in Table 2.


Photo 2

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TABLE 2

WASTE OIL DRUM SAMPLE RESULTS (Bacon Island)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
	TTLC (mg/kg)	0.5' BGS* Sample # DWB-23a (adjacent to drums)	2.0' BGS Sample # DWB-24b1 (adjacent to drums)	2.0' BGS Sample # DWB-24b2 (split sample)
METALS:				
Arsenic	500	11	4	5
Barium	10,000	150	42	50
Chromium (total)	2,500	33	6	6
Cobalt	8,000	10	1.6	1.7
Copper	2,500	25	4	4
Lead	1,000	19	1	2
Mercury	20	0.08	ND	ND
Molybdenum	3,500	3	3	3
Nickel	2,000	46	9	10
Vanadium	2,400	52	11	13
Zinc	5,000	160	5	7
CHLORINATED PESTICIDES				
	Reporting limit (mg/kg)	0.5' BGS Sample # DWB-23a (adjacent to drums)	2.0' BGS Sample # DWB-24b1 (adjacent to drums)	2.0' BGS Sample # DWB-24b2 (split sample)
gamma-BHC (Lindane)	0.3	0.32	ND	ND
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWB-23a (adjacent to drums)	2.0' BGS Sample # DWB-24b1 (adjacent to drums)	2.0' BGS Sample # DWB-24b2 (split sample)
pH	None	4.6	4.4	4.2
Oil and Grease	None	**28,300**	144	132

* BGS = Below ground surface   ND = None Detected

The surface soil sample collected near the waste oil drums revealed high levels of oil and grease (highlighted in red) that may require remediation. However the two split samples collected at two feet below ground surface contained 99.5% less. Trace amounts of Lindane were also detected in the surface sample. No other samples detected the presence of an element or compound at a level of concern, nor do they exceed the regulatory threshold value (if available).

3.1.3 North Farm Headquarters Sample Results: Oil Tank

Two aboveground storage tanks and one 55-gallon drum were identified in the Phase I ESA report. The tanks and drum are located on the north side of the northernmost storage shed at the north farm headquarters (Photos 3 and 4). Stained soil was observed in their vicinity. Surface and depth samples were collected between the containers, where the worse stain was

Photo 3

Photo 4

observed. Sample results are shown in Table 3.

TABLE 3

WASTE OIL TANK SAMPLE RESULTS *(Bacon Island)*			
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)	
	TTLC (mg/kg)	0.5' BGS* Sample # DWB-25a (between tank and drums)	2.0' BGS Sample # DWB-25b
METALS			
Arsenic	500	8	14
Barium	10,000	120	82
Chromium (total)	2,500	26	12
Cobalt	8,000	8.3	6.9
Copper	2,500	20	9
Lead	1,000	16	3
Mercury	20	0.05	0.03
Molybdenum	3,500	2	5
Nickel	2,000	41	24
Vanadium	2,400	44	29
Zinc	5,000	240	19
OTHER			
	REGULATORY LIMIT	0.5' BGS Sample # DWB-25a (between tank and drums)	2.0' BGS Sample # DWB-25b
pH	None	4.6	3.8
Oil and Grease	None	**195,000**	126
* BGS = Below ground surface ND = None Detected			

The surface soil sample collected between the tank and drum revealed extremely high levels of oil and grease (highlighted in red) that may require remediation. No other samples detected the presence of an element or compound at a level of concern, nor do they exceed the regulatory threshold value (if available).

3.1.4 North Farm Headquarters Sample Results: Wash-down Area

An equipment wash-down area was identified during the Phase I ESA. The wash-down area is located on the south side of the packing shed at the north farm headquarters. Wet soil was observed at this location. However, it is often difficult to distinguish between soil that is wet with water and soil stained with chemicals. Therefore, samples were collected at this location (Photo 5). Authoritative surface and depth samples were collected where the majority of the wash-down rinseate seem to collect. Sample results are shown in Table 4.

Photo 5

TABLE 4

WASH-DOWN AREA SAMPLE RESULTS *(Bacon Island)*			
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)	
	TTLC (mg/kg)	0.5' BGS* Sample # DWB-26a	2.0' BGS Sample # DWB-26b
METALS			
Arsenic	500	12	3
Barium	10,000	120	28
Chromium (total)	2,500	22	3
Cobalt	8,000	4.8	1.2
Copper	2,500	20	2
Lead	1,000	9	1
Mercury	20	0.03	ND
Molybdenum	3,500	4	1
Nickel	2,000	26	6
Vanadium	2,400	44	7.3
Zinc	5,000	55	7
OTHER			
	REGULATORY LIMIT	0.5' BGS Sample # DWB-26a	2.0' BGS Sample # DWB-26b
pH	None	6.4	6.2
Oil and Grease	None	291	54
* BGS = Below ground surface ND = None Detected			

The surface soil sample collected down-gradient of the wash-down area revealed low levels of oil and grease. No other elements or compounds were detected at levels that exceeded the regulatory threshold values (if available).

3.1.5 North Farm Headquarters Sample Results: Aboveground Storage Tanks


Photo 6

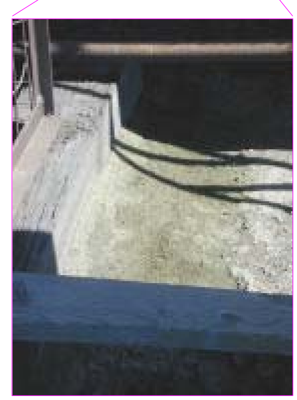
Photo 7

The Phase I ESA identified two aboveground storage tanks approximately one-eighth mile southeast of the packing shed. A fenced enclosure in this area also contained four 55-gallon drums and one 5-gallon container. Stained soil was observed under the 55-gallon drums as well as in the vicinity of the 750-gallon tank (Photos 6-7). SAS staff noted that upon visiting this location to collect samples, that the drums, fence, and smaller tank were absent. One surface sample was collected. Sample results are shown in Table 5.

TABLE 5

ABOVEGROUND STORAGE TANKS SAMPLE RESULTS *(Bacon Island)*		
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)
	TTLC (mg/kg)	0.5' BGS* Sample # DWB-27a
METALS		
Arsenic	500	10
Barium	10,000	140
Beryllium	75	0.5
Chromium (total)	2,500	37
Cobalt	8,000	8.9
Copper	2,500	29
Lead	1,000	270
Mercury	20	0.1
Molybdenum	3,500	3
Nickel	2,000	42
Vanadium	2,400	60
Zinc	5,000	53
OTHER		
	REGULATORY LIMIT	0.5' BGS Sample # DWB-27a
pH	None	3.9
Oil and Grease (mg/kg)	None	**17,800**
* BGS = Below ground surface		

The surface soil sample collected revealed high levels of oil and grease (highlighted in red) that may require remediation. No other elements or compounds were detected at levels that exceeded the regulatory threshold values (if available).

3.1.6 West Side Shed Sample Results: Fuel Pump

The Phase I ESA identified two aboveground storage tanks along the northwest levee road. The tanks are apparently supply fuel for the valve downhill from it (Photo 8). Stained soil was observed in the area surrounding the pump. One surface sample and one depth sample was collected. Sample results are shown in Table 6.

Photo 8

TABLE 6

FUEL PUMP SAMPLE RESULTS *(Bacon Island)*				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWB-28a (adjacent to pump)	2.0' BGS Sample # DWB-28b1 (adjacent to pump)	2.0' BGS Sample # DWB-28b2 (split sample)
Arsenic	500	8	5	4
Barium	10,000	250	110	110
Cadmium	1,000	0.05	ND	ND
Chromium (total)	2,500	12	27	26
Cobalt	8,000	38	7.8	7.7
Copper	2,500	96	22	22
Lead	1,000	0.06	15	14
Mercury	20	5	0.06	0.06
Molybdenum	3,500	39	2	1
Nickel	2,000	ND	29	29
Vanadium	2,400	31	42	41
Zinc	5,000	290	280	270
PETROLEUM HYDROCARBONS				
	Reporting limit (mg/kg)	0.5' BGS Sample # DWB-28a (adjacent to pump)	2.0' BGS Sample # DWB-28b1 (adjacent to pump)	2.0' BGS Sample # DWB-28b2 (split sample)
Xylenes (Total)	0.013	ND	0.10	0.10
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWB-28a (adjacent to pump)	2.0' BGS Sample # DWB-28b1 (adjacent to pump)	2.0' BGS Sample # DWB-28b2 (split sample)
pH	None	5.1	5.5	5.6
Oil and Grease	None	**296,000**	**35,500**	**35,300**
* BGS = Below ground surface ND = None Detected				

The soil samples collected near the fuel pump revealed high levels of oil and grease, especially in the surface sample (highlighted in red) that may require remediation. The subsurface samples also detected the presence xylene, a component of gasoline. In addition, an elevated level of mercury was detected in the surface sample. Although the concentration does not exceed the TTLC, it is significantly higher than what was detected approximately two feet below. No other elements or compounds were detected at levels that exceeded the regulatory threshold values (if available).

3.1.7 West Side Shed Sample Results: Burn Drum

The Phase I ESA identified ten 55-gallon drums and approximately 20 tires at the northeast end of the shed. None of the drums were labeled. No signs of leakage or spillage were observed in the area surrounding the drums. One open drum appeared to be used to burn trash. Within the debris in the drum, burnt oil filters were observed (Photo 9). One surface sample and one depth sample were collected. Sample results are


Photo 9

shown in Table 7.

TABLE 7

BURN DRUM SAMPLE RESULTS (Bacon Island)			
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)	
METALS			
	TTLC (mg/kg)	0.5' BGS* Sample # DWB-29a	2.0' BGS Sample # DWB-29b
Arsenic	500	5	11
Barium	10,000	130	120
Chromium (total)	2,500	19	24
Cobalt	8,000	5.3	5.5
Copper	2,500	130	27
Lead	1,000	52	17
Mercury	20	0.05	0.07
Molybdenum	3,500	3	4
Nickel	2,000	23	24
Vanadium	2,400	24	46
Zinc	5,000	520	43
CHLORINATED PESTICIDES			
	REPORTING LIMIT	0.5' BGS Sample # DWB-29a	2.0' BGS Sample # DWB-29b
p,p'-DDE	0.3	ND	0.01
OTHER			
	REGULATORY LIMIT	0.5' BGS Sample # DWB-29a	2.0' BGS Sample # DWB-29b
pH	None	5.4	4.8
Oil and Grease	None	**89,400**	**2,490**
* BGS = Below ground surface ND = None Detected			

The soil samples collected near the burn drum revealed high levels of oil and grease, especially in the surface sample (highlighted in red) that may require remediation. The subsurface samples also detected the a trace amount of p,p'-DDE, a pesticide. No other samples detected the presence of an element or compound at a level of concern, nor do they exceed the regulatory threshold value (if available).

3.2 Bouldin Island Soil Samples

Authoritative soil samples were collected on Bouldin Island at areas where extensive stained soil was observed or suspected. Specifically, samples were collected at an aboveground fuel tank located at the farm maintenance headquarters along the east side of the island. A sample was also collected were numerous 55-gallon drums were observed during the Phase I ESA site reconnaissance. A background sample was also collected at this island.

3.2.1 Farm Headquarters Fuel Tank

The Phase I ESA identified stained soil under two aboveground fuel tanks at the farm headquarters (Photos 10-11). Samples were collected from the stained area along the south side of the tanks. Sample results are shown in Table 8.


Photo 10


Photo 11

TABLE 8

FUEL TANK SOIL SAMPLE RESULTS *(Bouldin Island)*					
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)			
METALS					
	TTLC (mg/kg)	0.5' BGS* Sample # DWL-30a1	0.5' BGS Sample # DWL-30a2 (split sample)	2.0' BGS Sample # DWL-30b	4.0' BGS Sample # DWL-30c
Arsenic	500	4	4	6	2
Barium	10,000	110	110	140	58
Cadmium	1,000	ND	ND	0.8	ND
Chromium (total)	2,500	2	20	20	7
Cobalt	8,000	8.5	8.8	6.8	3.8
Copper	2,500	22	22	19	5
Lead	1,000	20	17	8	2
Mercury	20	0.08	0.15	0.08	ND
Nickel	2,000	24	24	21	11
Vanadium	2,400	32	ND	31	17
Zinc	5,000	190	32	310	17
PETROLEUM HYDROCARBONS					
	Reporting limit (mg/kg)	0.5' BGS Sample # DWL-30a1	0.5' BGS Sample # DWL-30a2 (split sample)	2.0' BGS Sample # DWL-30b	4.0' BGS Sample # DWL-30c
Toluene	0.013	0.016	0.018	ND	0.016
Ethyl benzene	0.013	ND	ND	ND	0.057
Xylenes (Total)	0.013	0.045	0.041	0.12	0.43
OTHER					
	REGULATORY LIMIT	0.5' BGS Sample # DWL-30a1	0.5' BGS Sample # DWL-30a2 (split sample)	2.0' BGS Sample # DWL-30b	4.0' BGS Sample # DWL-30c
pH	None	5.8	5.8	5.6	6.6
Oil and Grease	None	**84,600**	**85,800**	**84,000**	**52,300**
* BGS = Below ground surface ND = None Detected					

The soil samples collected near the fuel tanks revealed high levels of oil and grease that have apparently saturated down at least four feet below ground surface (highlighted in red). Trace amounts of toluene, ethyl benzene, and xylene, which are components of gasoline, were also detected in the samples. No other elements or compounds were detected at levels that exceed the regulatory threshold values (if available).

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3.2.2 Farm Headquarters: Former Drum Storage Area

The Phase I ESA identified approximately twenty-five 55-gallon drums and farm machinery parts west of the equipment storage shed. Some of the drums were observed to be empty. However, others were sealed and unlabeled. Stained soil was observed in the area under and around the drums and equipment (Photos 12-13).

Photo 12

Photo 13

Upon visiting this location for collection of soil samples, SAS staff noted that all trash, drums, and equipment, had been removed. SAS staff also noted the absence of the storage shed. Note that Photo 14 was taken from the same location and direction as Photo 12. One surface sample was collected where SAS staff could best determine the location of the drums. Sample results are shown in Table 9.

Photo 14

TABLE 9

FORMER DRUM STORAGE AREA SAMPLE RESULTS
(Bouldin Island)

CONSTITUENT	REGULATORY LIMITS	SAMPLE RESULTS (mg/kg)
METALS		
	TTLC (mg/kg)	0.5' BGS* Sample # DWL-32a
Arsenic	500	4
Barium	10,000	130
Beryllium	75	
Chromium (total)	2,500	17
Cobalt	8,000	8.1
Copper	2,500	38
Lead	1,000	52
Mercury	20	0.06
Molybdenum	3,500	17
Nickel	2,000	17
Vanadium	2,400	38
Zinc	5,000	210
OTHER		
	REGULATORY LIMIT	0.5' BGS Sample # DWL-32a
pH	None	6.2
Oil and Grease (mg/kg)	None	**112,000**
* BGS = Below ground surface		

The soil sample collected at the former drum and equipment storage area revealed high levels of oil and grease (highlighted in red). No other elements or compounds were detected at levels that exceed any regulatory threshold value (if available).

3.2.3 Background Sample

Per the sampling protocol, a single background sample was collected on Bouldin Island. The sample was collected approximately one mile west (inland) of the eastern tip of the island. The sample was collected from the edge of a fallow farm field. Sample results are shown in Table 10.

TABLE 10

BACKGROUND SAMPLE RESULTS (Bouldin Island)		
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)
METALS		
	TTLC (mg/kg)	0.5' BGS* Sample # DWL-31a
Arsenic	500	14
Barium	10,000	170
Chromium (total)	2,500	38
Cobalt	8,000	13
Copper	2,500	26
Lead	1,000	10
Mercury	20	0.07
Molybdenum	3,500	1
Nickel	2,000	46
Vanadium	2,400	56
Zinc	5,000	61
CHLORINATED PESTICIDES		
	REPORTING LIMIT	0.5' BGS Sample # DWL-31a
p,p'-DDD	0.3	0.049
p,p'-DDE	0.3	0.17
p,p'-DDT	0.3	0.089
OTHER		
	REGULATORY LIMIT	0.5' BGS Sample # DWL-31a
pH	None	6.0
Oil and Grease (mg/kg)	None	ND
* BGS = Below ground surface		

The background soil sample collected in the field did not indicate the presence of an element or compound at levels that exceeded any regulatory threshold value (if available).

3.3 Holland Tract Soil Samples

Authoritative soil samples were collected on Holland Tract at areas where extensive stained soil was observed or suspected. Specifically, samples were collected at a storage shed and a portable aboveground storage tank along the east border, and at a waste oil storage site in the center of the tract. Three background samples were also collected at this location.

3.3.1 East Side Barn


Photo 16


Photo 15

The Phase I ESA identified a barn situated along the east side of the tract (Photo 15). With in the barn, it was noted that the concrete foundation was stained along the west side. Further observation noted that the staining ran down the outside of the foundation and into the soil (Photo 16). Two sets of samples were collected at this location. One set, consisting of a surface and subsurface sample, was collected close to the foundation. The second set of samples were collected approximately four feet west (down gradient) from the foundation. Sample results are shown in Table 11.

TABLE 11

EAST SIDE BARN SAMPLE RESULTS
(Holland Tract)

CONSTITUENT	REGULATORY LIMITS	SAMPLE RESULTS (mg/kg)			
METALS					
	TTLC (mg/kg)	0.5' BGS* Sample # DWH-1a (near foundation)	1.5' BGS Sample # DWH-1b (near foundation)	0.5' BGS Sample # DWH-2a (4 feet from foundation)	1.5' BGS Sample # DWH-2b (4 feet from foundation)
Arsenic	500	3	6	2	4
Barium	10,000	44	86	28	70
Beryllium	75	0.2	0.3	ND	ND
Cadmium	1,000	1.3	ND	ND	ND
Chromium (total)	2,500	13	23	9	17
Cobalt	8,000	3.2	6.3	2.6	3.8
Copper	2,500	10	29	4	16
Lead	1,000	20	31	3	18
Mercury	20	ND	0.04	ND	0.03
Molybdenum	3,500	2	4	ND	3
Nickel	2,000	13	23	10	19
Thallium	700	16	ND	ND	ND
Vanadium	2,400	530	36	13	30
Zinc	5,000	4.6	310	35	68

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TABLE 11 *(continued)*

EAST SIDE BARN SAMPLE RESULTS *(Holland Tract)*					
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)			
CHLORINATED PESTICIDES					
	Reporting limit (mg/kg)	0.5' BGS Sample # DWH-1a (near foundation)	1.5' BGS Sample # DWH-1b (near foundation)	0.5' BGS Sample # DWH-2a (4 feet from foundation)	1.5' BGS Sample # DWH-2b (4 feet from foundation)
p,p'-DDE	0.013	ND	0.045	ND	0.35
Diedrin	0.013	ND	0.34	ND	1.5
Endrin Ketone	0.013	ND	ND	ND	0.022
OTHER					
	REGULATORY LIMIT	0.5' BGS Sample # DWH-1a (near foundation)	1.5' BGS Sample # DWH-1b (near foundation)	0.5' BGS Sample # DWH-2a (4 feet from foundation)	1.5' BGS Sample # DWH-2b (4 feet from foundation)
pH	None	4.6	6.4	6.1	5.5
Oil and Grease	None	192	93	ND	36
* BGS = Below ground surface ND = None Detected					

The soil samples collected near the barn foundation did not revealed high levels petroleum hydrocarbons as suspected. However, traces of chlorinated pesticides were detected in both subsurface samples. No other elements or compounds were detected at a level that exceeded the regulatory threshold value (if available).

3.3.2 Equipment Staging Area

The Phase I ESA identified a farm equipment staging area approximately one-half mile south of the north tip of the island. Numerous tractors, trucks, and implements were observed at this location. A 10,000 gallon diesel fuel trailer was observed here (Photo 17). The soil under the trailer was stained.

Photo 17

Two 55-gallon drums at this location are apparently used for burning trash. Approximately twelve more unlabeled 55-gallon drums were observed at this location. Their use could not be determined. Five 55-gallon drums at this area were labeled as being tractor hydraulic fluid barn situated along the east side of the tract (Photo 18). Two sets of samples were collected at this location. One set, consisting of a surface and subsurface sample, was collected at the stained soil by the 10,000 gallon trailer. The second sample set was collected from the stain between the 55-gallon drums. Sample results are shown in Table 12.

Photo 18

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TABLE 12

EQUIPMENT STAGING AREA SAMPLE RESULTS (Holland Tract)					
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)			
METALS					
	TTLC (mg/kg)	0.5' BGS* Sample # DWH-3a (under tank)	2.0' BGS Sample # DWH-3b (under tank)	0.5' BGS Sample # DWH-4a (between drums)	2.0' BGS Sample # DWH-4b (between drums)
Arsenic	500	2	1	2	3
Barium	10,000	25	27	30	35
Chromium (total)	2,500	9	11	9	10
Cobalt	8,000	2.3	3.6	2.5	2.5
Copper	2,500	3	4	3	4
Lead	1,000	2	2	8	3
Molybdenum	3,500	ND	ND	ND	1
Nickel	2,000	9	13	10	11
Vanadium	2,400	12	18	13	15
Zinc	5,000	15	11	35	9
CHLORINATED PESTICIDES					
	Reporting limit (mg/kg)	0.5' BGS Sample # DWH-3a (under tank)	2.0' BGS Sample # DWH-3b (under tank)	0.5' BGS Sample # DWH-4a (between drums)	2.0' BGS Sample # DWH-4b (between drums)
Endosulfan	0.006	ND	ND	0.165	ND
PETROLEUM HYDROCARBONS					
	Reporting limit (mg/kg)	0.5' BGS Sample # DWH-3a (under tank)	2.0' BGS Sample # DWH-3b (under tank)	0.5' BGS Sample # DWH-4a (between drums)	2.0' BGS Sample # DWH-4b (between drums)
Xylene	0.0025	0.26	ND	ND	ND
SEMIVOLITILE ORGANIC COMPOUNDS					
	Reporting limit (mg/kg)	0.5' BGS Sample # DWH-3a (under tank)	2.0' BGS Sample # DWH-3b (under tank)	0.5' BGS Sample # DWH-4a (between drums)	2.0' BGS Sample # DWH-4b (between drums)
Naphthalene	0.033	12	ND	ND	ND
OTHER					
	REGULATORY LIMIT	0.5' BGS Sample # DWH-3a (under tank)	2.0' BGS Sample # DWH-3b (under tank)	0.5' BGS Sample # DWH-4a (between drums)	2.0' BGS Sample # DWH-4b (between drums)
pH	None	7.6	7.7	7.1	7.6
Oil and Grease	None	**51,800**	ND	**75,600**	ND
* BGS = Below ground surface ND = None Detected					

The soil samples collected at the equipment staging area revealed high levels of oil and grease on the surface (highlighted in red). Traces of a chlorinated pesticide were detected on the surface between the 55-gallon drums. Xylene was detected on the surface near the fuel tank. Naphthalene was also detected on the surface under the tank. No other elements or compounds were detected at a level that exceeded the regulatory threshold value (if available).

3.3.3 Waste Oil Area


Photo 19

The Phase I ESA identified a waste oil storage area situated one and one-half miles north of the south levee entrance gate (Photo 19). Observations at this location included one 500-gallon aboveground storage tank, 28 55-gallon drums, approximately 30 used engine oil filters, and two tractor batteries. Wide-spread soil staining was observed in the area surrounding the drums and 500-gallon tank. Soil samples were collected in four locations: eight feet north of the telephone pole, near the palette of batteries, under the storage tank, and approximately 20 feet west of the tank among the 55-gallon drums. Sample results are shown in Tables 13-15.

TABLE 13

WASTE OIL AREA SAMPLE RESULTS *(Holland Tract)*					
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)			
METALS					
	TTLC (mg/kg)	0.5' BGS* Sample # DWH-5a (8' north of pole)	2.0' BGS Sample # DWH-5b (8' north of pole)	0.5' BGS Sample # DWH-7a (near batteries)	2.0' BGS Sample # DWH-7b (near batteries)
Arsenic	500	3	3	2	2
Barium	10,000	41	36	36	19
Chromium (total)	2,500	10	11	9	9
Cobalt	8,000	2.5	2.8	2.5	2.7
Copper	2,500	8	4	11	4
Lead	1,000	8	4	16	3
Molybdenum	3,500	1	ND	ND	ND
Nickel	2,000	11	12	10	10
Vanadium	2,400	13	15	13	12
Zinc	5,000	290	45	200	13
OTHER					
	REGULATORY LIMIT	0.5' BGS Sample # DWH-5a (8' north of pole)	2.0' BGS Sample # DWH-5b (8' north of pole)	0.5' BGS Sample # DWH-7a (near batteries)	2.0' BGS Sample # DWH-7b (near batteries)
pH	None	6.5	7.8	5.5	7.4
Oil and Grease	None	**51,800**	ND	**75,600**	ND
* BGS = Below ground surface ND = None Detected					

The soil samples collected north of the power pole and near the batteries revealed high levels of oil and grease (highlighted in red). No other element or compound was detected at levels that exceeded the regulatory threshold value (if available).

TABLE 14

WASTE OIL AREA SAMPLE RESULTS (Holland Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWH-6a (near 500 gallon tank)	2.0' BGS Sample # DWH-6b1 (near 500 gallon tank)	2.0' BGS Sample # DWH-6b2 (split sample)
Arsenic	500	3	ND	ND
Barium	10,000	47	18	19
Chromium (total)	2,500	11	11	11
Cobalt	8,000	2.2	2.2	2.3
Copper	2,500	14	3	2
Lead	1,000	13	2	2
Molybdenum	3,500	2	ND	ND
Nickel	2,000	10	9	10
Vanadium	2,400	10	17	18
Zinc	5,000	360	12	10
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWH-6a (near 500 gallon tank)	2.0' BGS Sample # DWH-6b1 (near 500 gallon tank)	2.0' BGS Sample # DWH-6b2 (split sample)
pH	None	6.5	8.0	8.0
Oil and Grease	None	**109,000**	**153**	**129**
* BGS = Below ground surface ND = None Detected				

The soil samples collected near the 500-gallon aboveground storage tank revealed high levels of oil and grease, mostly on the surface (highlighted in red). No other element or compound was detected at levels that exceeded the regulatory threshold value (if available).

TABLE 15

WASTE OIL AREA SAMPLE RESULTS (Holland Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWH-8a (20 feet west of drums)	2.0' BGS Sample # DWH-8b1 (20 feet west of drums)	2.0' BGS Sample # DWH-8b2 (split sample)
Arsenic	500	2	1	1
Barium	10,000	39	28	27
Cadmium	1,000	0.9	ND	ND
Chromium (total)	2,500	10	11	10
Cobalt	8,000	2.3	2.3	2.2
Copper	2,500	8	3	3
Lead	1,000	9	3	3
Nickel	2,000	10	10	10
Vanadium	2,400	12	13	15
Zinc	5,000	43	11	11

TABLE 15 *(continued)*

WASTE OIL AREA SAMPLE RESULTS (Holland Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
CHLORINATED PESTICIDES				
	Reporting limit (mg/kg)	0.5' BGS Sample # DWH-8a (20 feet west of drums)	2.0' BGS Sample # DWH-8b1 (20 feet west of drums)	2.0' BGS Sample # DWH-8b2 (split sample)
p,p'-DDT	0.006	0.036	ND	ND
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWH-8a (20 feet west of drums)	2.0' BGS Sample # DWH-8b1 (20 feet west of drums)	2.0' BGS Sample # DWH-8b2 (split sample)
pH	None	7.0	7.9	8.0
Oil and Grease	None	**930**	ND	ND
* BGS = Below ground surface ND = None Detected				

The soil samples collected west of the tank and drums revealed elevated levels of oil and grease on the surface (highlighted in red). No other element or compound was detected at levels that exceed the regulatory threshold value (if available).

3.3.4 Background Sample

Per the sampling protocol, a three background samples were collected on Holland Tract. The samples were collected at three separate locations: center of north levee road on north side of tract, by the tidal gauging station along the east side of the tract, and near the gauging station along the east side of the tract, two miles north of Holland Tract Road. Sample results are shown in Table 16.

TABLE 16

BACKGROUND SAMPLE RESULTS (Holland Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWH-9a (north levee road)	0.5' BGS Sample # DWH-10a (east side by tidal gauge)	0.5' BGS Sample # DWH-11a (east side by gauging station)
Arsenic	500	3	2	2
Barium	10,000	36	24	33
Chromium (total)	2,500	10	8	7
Cobalt	8,000	2.8	2.5	2
Copper	2,500	5	5	3
Lead	1,000	3	2	2
Nickel	2,000	11	10	9
Vanadium	2,400	15	12	11
Zinc	5,000	16	13	11

TABLE 16 *(continued)*

BACKGROUND SAMPLE RESULTS *(Holland Tract)*				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
OTHER				
	REGULATORY LIMIT	0.5' BGS* Sample # DWH-9a (north levee road)	0.5' BGS Sample # DWH-10a (east side by tidal gauge)	0.5' BGS Sample # DWH-11a (east side by gauging station)
pH	None	6.9	6.7	7.1
Oil and Grease	None	ND	ND	ND
* BGS = Below ground surface ND = None Detected				

None of the background soil samples detected the presence of an element or compound at a level of concern, nor do they exceed the regulatory threshold value (if available).

3.4 Webb Tract

Authoritative soil samples were collected on Webb Tract at areas where extensive stained soil was observed or suspected. Specifically, samples were collected around fuel and oil storage tanks at the farm headquarters on the west tract border. Samples were also collected near the pumps at the gas well on the south tract border. Background samples were also collected at this tract.

3.4.1 Farm Headquarters: Burn Drums

The Phase I ESA identified three 55-gallon drums north of the maintenance shed. These drums were apparently used for burning trash. A dumpster was observed by the drums that apparently was where ash from the drums was placed. Among the waste in the dumpster, burned heavy equipment oil filters were observed (Photos 20-21). Soil samples were collected in the area between the drums and trash bin. Sample results are shown in Table 17.

Photo 20

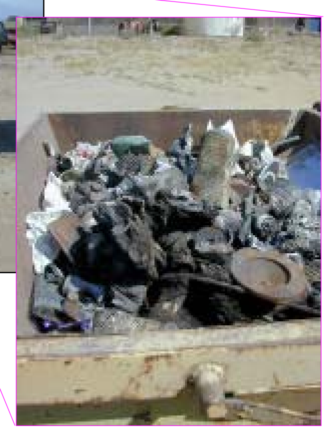

Photo 21

TABLE 17

BURN DRUM SAMPLE RESULTS *(Webb Tract)*			
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)	
METALS			
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-12a	2.0' BGS Sample # DWW-12b
Arsenic	500	3	1
Barium	10,000	65	14
Cadmium	1,000	0.3	ND
Chromium (total)	2,500	7	4
Cobalt	8,000	1.6	1.7
Copper	2,500	11	1
Lead	1,000	75	2
Nickel	2,000	6	6
Vanadium	2,400	9.4	8.5
Zinc	5,000	440	8
OTHER			
	REGULATORY LIMIT	0.5' BGS Sample # DWW-12a	2.0' BGS Sample # DWW-12b
pH	None	6.6	8.2
Oil and Grease	None	**79,200**	ND

* BGS = Below ground surface ND = None Detected

The soil samples collected between the drums and trash bin revealed elevated levels of oil and grease on the surface (highlighted in red). No other element or compound was detected at levels that exceeded the regulatory threshold value (if available).

3.4.2 Farm Headquarters: Maintenance Building Staining – West Side

The Phase I ESA identified stained soil on the west side of the equipment maintenance building (Photo 22). Samples were collected approximately 20 feet west of the northwest corner of the building. Sample results are shown in Table 18.

Photo 22

TABLE 18

MAINTENANCE BUILDING STAINING SAMPLE RESULTS *(Webb Tract)*			
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)	
METALS			
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-13a	2.0' BGS Sample # DWW-13b
Arsenic	500	4	5
Barium	10,000	31	38
Cadmium	1,000	1.3	ND
Chromium (total)	2,500	14	6
Cobalt	8,000	1.8	2.4
Copper	2,500	110	2
Lead	1,000	5	2
Nickel	2,000	7	7
Vanadium	2,400	24	12
Zinc	5,000	140	9
OTHER			
	REGULATORY LIMIT	0.5' BGS Sample # DWW-13a	2.0' BGS Sample # DWW-13b
pH	None	6.0	8.1
Oil and Grease	None	**8,100**	ND
* BGS = Below ground surface ND = None Detected			

The soil samples collected on the west side of the maintenance building revealed elevated levels of oil and grease on the surface (highlighted in red). No other samples detected the presence of an element or compound at a level of concern, nor do they exceed the regulatory threshold value (if available).

3.4.3 Farm Headquarters: Maintenance Building Drums

The Phase I ESA identified stained soil on the north side of the equipment maintenance building by open 55-gallon drums and aboveground storage tanks (Photo 23). Samples were collected on the east side of the drums and tanks. Sample results are shown in Table 19.

Photo 23

TABLE 19

MAINTENANCE BUILDING DRUMS SAMPLE RESULTS *(Holland Tract)*				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-14a	2.0' BGS Sample # DWW-14b1	2.0' BGS Sample # DWW-14b2 (split sample)
Arsenic	500	3	3	2
Barium	10,000	31	16	14
Chromium (total)	2,500	6	5	5
Cobalt	8,000	1.8	1.6	1.6
Copper	2,500	7	1	
Lead	1,000	11	2	1
Nickel	2,000	6	5	5
Vanadium	2,400	8.7	7.2	7.3
Zinc	5,000	390	12	8
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWW-14a	2.0' BGS Sample # DWW-14b1	2.0' BGS Sample # DWW-14b2 (split sample)
pH	None	5.9	7.7	7.9
Oil and Grease	None	**125,000**	**1,230**	**1,350**
* BGS = Below ground surface ND = None Detected				

The soil samples collected on by the oil drums and tanks revealed high levels of oil and grease (highlighted in red). No other element or compound was detected at levels that exceeded the regulatory threshold value (if available).

3.4.4 Farm Headquarters: Maintenance Building Fuel Tanks

The Phase I ESA identified stained soil on the north side of the equipment maintenance building under an aboveground diesel fuel tank (Photo 24). Additional staining was identified in the area surrounding a fuel tank in the same location (Photo 25). Soil samples were collected under the tank. Sample results are shown in Table 20.


Photo 24


Photo 25

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TABLE 20

FUEL TANKS SAMPLE RESULTS (Webb Tract)					
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)			
METALS					
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-15a (under fuel tank valve)	2.0' BGS Sample # DWW-15b (under fuel tank valve)	0.5' BGS Sample # DWW-16a (north of fuel tank)	2.0' BGS Sample # DWW-16b (north of fuel tank)
Arsenic	500	4	37	7	2
Barium	10,000	36	21	48	33
Chromium (total)	2,500	6	6	6	6
Cobalt	8,000	1.6	2	2.1	2.3
Copper	2,500	3	1	3	2
Lead	1,000	6	2	3	2
Nickel	2,000	6	6	6	7
Vanadium	2,400	9.2	8.2	11	9.7
Zinc	5,000	390	10	17	9
PETROLEUM HYDROCARBONS					
	Reporting limit **(mg/kg)**	0.5' BGS Sample # DWW-15a (under fuel tank valve)	2.0' BGS Sample # DWW-15b (under fuel tank valve)	0.5' BGS Sample # DWW-16a (north of fuel tank)	2.0' BGS Sample # DWW-16b (north of fuel tank)
Xylene	0.013	ND	ND	0.17	0.013
SEMIVOLATILE ORGANIC COMPOUNDS					
	Reporting limit **(mg/kg)**	0.5' BGS Sample # DWW-15a (under fuel tank valve)	2.0' BGS Sample # DWW-15b (under fuel tank valve)	0.5' BGS Sample # DWW-16a (north of fuel tank)	2.0' BGS Sample # DWW-16b (north of fuel tank)
Naphthalene	50	ND	ND	ND	0.45
OTHER					
	REGULATORY LIMIT	0.5' BGS Sample # DWW-15a (under fuel tank valve)	2.0' BGS Sample # DWW-15b (under fuel tank valve)	0.5' BGS Sample # DWW-16a (north of fuel tank)	2.0' BGS Sample # DWW-16b (north of fuel tank)
pH	None	7.3	7.8	7.4	8.2
Oil and Grease	None	**51,800**	ND	**75,600**	ND
* BGS = Below ground surface ND = None Detected					

The soil samples collected under the fuel tank fill valve and north of the diesel fuel tank revealed high levels of oil and grease on the surface (highlighted in red). Samples also detected levels of xylene and naphthalene. No other element or compound was detected at levels that exceeded the regulatory threshold value (if available).

3.4.5 Gas Well Facility

The Phase I ESA identified a gas well facility situated along the south levee road approximately two miles west of the pumping station (Photo 26). Stained soil was observed under the elevated pump structure. Samples were collected is this location. Sample results are shown in Table 21.

Photo 26

TABLE 21

GAS WELL SAMPLE RESULTS (Webb Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-20a1	0.5' BGS Sample # DWW-20a2 (split sample)	2.0' BGS Sample # DWW-20b
Arsenic	500	5	4	13
Barium	10,000	1,500	1,500	250
Chromium (total)	2,500	21	17	49
Cobalt	8,000	5.1	5.5	8.1
Copper	2,500	11	12	30
Lead	1,000	9	9	7
Mercury	20	0.15	0.21	0.04
Nickel	2,000	21	22	45
Vanadium	2,400	21	23	91
Zinc	5,000	52	58	49
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWW-20a1	0.5' BGS Sample # DWW-20a2 (split sample)	2.0' BGS Sample # DWW-20b
pH	None	6.6	6.6	5.4
Oil and Grease	None	**67,200**	**63,000**	**870**

* BGS = Below ground surface ND = None Detected

The soil samples collected under the well pump revealed high levels of oil and grease (highlighted in red). Elevated levels of barium were also detected. No other element or compound was detected at levels that exceeded the regulatory threshold value (if available).

3.4.6 Background Samples

Per the sampling protocol, a three background samples were collected on Webb Tract. The samples were collected at three separate locations: northernmost tip of tract, one-half mile west of residence on eastern point of tract, and in the field northeast of the gas well. Sample results are shown in Table 22.

TABLE 22

BACKGROUND SAMPLE RESULTS (Webb Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-18a (north tip of tract)	0.5' BGS Sample # DWW-19a (east end of tract)	0.5' BGS Sample # DWW-21a (north of gas well)
Arsenic	500	5	7	18
Barium	10,000	90	97	260
Chromium (total)	2,500	41	30	48

TABLE 22 *(continued)*

BACKGROUND SAMPLE RESULTS (Webb Tract)				
CONSTITUENT	**REGULATORY LIMITS**	**SAMPLE RESULTS** (mg/kg)		
METALS				
	TTLC (mg/kg)	0.5' BGS* Sample # DWW-18a (north tip of tract)	0.5' BGS Sample # DWW-19a (east end of tract)	0.5' BGS Sample # DWW-21a (north of gas well)
Copper	2,500	24	24	45
Lead	1,000	6	8	11
Mercury	20	0.09	0.09	0.06
Molybdenum	3,500	ND	1	3
Nickel	2,000	59	32	47
Vanadium	2,400	42	43	100
Zinc	5,000	54	47	51
CHLORINATED PESTICIDES				
	Reporting limit (mg/kg)	0.5' BGS Sample # DWW-18a (north tip of tract)	0.5' BGS Sample # DWW-19a (east end of tract)	0.5' BGS Sample # DWW-21a (north of gas well)
Diedrin	0.3	ND	ND	0.058
OTHER				
	REGULATORY LIMIT	0.5' BGS Sample # DWW-18a (north tip of tract)	0.5' BGS Sample # DWW-19a (east end of tract)	0.5' BGS Sample # DWW-21a (north of gas well)
pH	None	5.7	5.4	4.5
Oil and Grease	None	ND	36	ND
* BGS = Below ground surface ND = None Detected				

None of the background soil samples detected the presence of an element or compound at a level of concern, nor do they exceed the regulatory threshold value (if available). However, diedrin, a chlorinated pesticide, was detected in the background sample collected in the field north of the gas well.

4.0 QUALITY ASSURANCE / QUALITY CONTROL

Duplicate samples, equipment blanks, and field blanks were collected during the sampling process to assess the precision of field collection techniques and laboratory sample handling. Such measures also help detect cross-contamination between sample locations.

The laboratory quality assurance/quality control (QA/QC) measures and chain-of-custody documents are found in Appendix E.

It should be noted that for ease of discussion in this section, only those sample analytes which were detected are displayed. In order to ease reporting and discussion, those samples which had no analyte detected were not displayed. (For example, no analytes were detected in any of the background samples. Therefore, no table of results is displayed in Section *4.2 Equipment Blanks.*) See Appendix B for the sample results summary. Appendix C contains the original Caltest analytical results.

4.1 Duplicate Soil Samples

Duplicate soil samples were collected at each island and tract. The duplicate samples serve as a QA/QC measure to assess the precision of the field collection process and the analytical laboratory (State 1995). Duplicate soil samples were prepared by placing a collected soil sample in a clean stainless steel bucket, homogenizing the soil with a clean stainless steel trowel or certified clean disposable scoop, and dividing the sample into two sample jars. Tables 23-26 illustrate the duplicate samples and their results.

Note that some samples and their duplicates were not exactly equal. The extent to which this difference is acceptable is defined by SW-846 Method 6020. Method 6020 specifies the following two expectations: 1) $\leq$ 20 Relative Percent Difference for analytes whose concentrations exceed the instrument detection level by a factor of >100; or 2) when the analyte concentrations are less than this factor of 100, a larger RPD is allowed (Gump).

TABLE 23

DUPLICATE SAMPLE ANALYSES
(Holland Island)

METALS

	Reporting Limit (mg/kg)	DWH-6b1	DWH-6b2	RPD	DWH-8b1	DWH-8b2	RPD
Arsenic	1	ND	ND	N/A	1	2	67
Barium	1	18	19	5	28	27	4
Chromium (total)	1	11	11	0	11	10	10
Cobalt	0.4	2.2	2.3	4	2.3	2.2	4

TABLE 23 *(continued)*

DUPLICATE SAMPLE ANALYSES *(Holland Island)*							
METALS							
Copper	1	3	3	0	3	3	0
Lead	1	2	2	0	3	3	0
Nickel	1	9	10	10	10	10	0
Vanadium	0.4	17	18	6	13	13	0
Zinc	4	12	10	18	11	11	0
OTHER							
Oil and Grease	None	153	129	17	ND	ND	N/A

RPD = Relative Percent Difference = $[(D_1\text{-}D_2)/[(D_1+D_2)/2]]$ X 100
ND = None Detected
N/A = Not Applicable

The RPD for duplicate samples collected at Holland Island are well below 20. Only the RPD of 67 for arsenic exceeds this difference. However, the analyte concentrations are 1 mg/kg, and 2 mg/kg, which are far less than 100 times the instrument detection level of 1. According to the Method 6020 guidelines, the reporting difference is acceptable.

TABLE 24

DUPLICATE SAMPLE ANALYSES *(Webb Tract)*							
METALS							
	Reporting Limit (mg/kg)	DWW-14b1	DWW-14b2	RPD	DWW-20a1	DWW-20a2	RPD
Arsenic	1	3	2	40	5	4	22
Barium	1	16	14	13	1500	1500	0
Chromium (total)	1	5	5	0	21	17	21
Cobalt	0.4	1.6	1.6	0	5.1	5.5	8
Copper	1	1	ND	200	11	12	9
Lead	1	2	1	67	9	9	0
Mercury	0.02	ND	ND	N/A	0.15	0.21	33
Nickel	1	5	5	0	21	22	5
Vanadium	0.4	7.2	7.3	1	21	23	9
Zinc	4	12	8	40	52	58	11
OTHER							
Oil and Grease	None	1,230	1,350	9	67,200	63,000	7

RPD = Relative Percent Difference = $[(D_1\text{-}D_2)/[(D_1+D_2)/2]]$ X 100
ND = None Detected
N/A = Not Applicable

The RPD for most of the duplicate samples collected at Webb Tract are well below 20. At least one RPD value exceeded 20 for arsenic, chromium, copper, lead, mercury, and zinc. However, the analyte concentrations for each of these are far less than 100 times their respective instrument detection levels. According to the Method 6020 guidelines, the reporting differences for duplicate samples at Webb Tract are acceptable.

TABLE 25

DUPLICATE SAMPLE ANALYSES *(Bacon Island)*							
METALS							
	Reporting Limit (mg/kg)	DWB-24b1	DWB-24b2	RPD	DWB-28b1	DWB-28b2	RPD
Arsenic	1	4	5	22	5	4	22
Barium	1	42	50	17	110	110	0
Chromium (total)	1	6	6	0	27	26	4
Cobalt	0.4	1.6	1.7	6	7.8	7.7	1
Copper	1	4	4	0	22	22	0
Lead	1	1	2	67	15	14	7
Mercury	0.02	ND	ND	NA	0.06	0.06	0
Molybdenum	1	3	3	0	2	1	67
Nickel	1	9	10	11	29	29	0
Vanadium	0.4	11	13	17	42	41	2
Zinc	4	5	7	33	280	270	4
AROMATIC & TOTAL PURGEABLE PETROLEUM HYDROCARBONS							
Xylenes (total)	0.013	ND	ND	NA	0.10	0.16	46
OTHER							
Oil and Grease	None	144	132	9	35,500	35,300	1

RPD = Relative Percent Difference = $[(D_1-D_2)/[(D_1+D_2)/2]] \times 100$
ND = None Detected
N/A = Not Applicable

The RPD for most of the duplicate samples collected at Bacon Island are well below 20. At least one RPD value exceeded 20 for arsenic, lead, molybdenum, and zinc. However, the analyte concentrations for each of these are far less than 100 times their respective instrument detection levels. As with samples collected at Webb tract, according to the Method 6020 guidelines, the reporting differences for duplicate samples at Bacon Island are acceptable.

TABLE 26

DUPLICATE SAMPLE ANALYSES *(Bouldin Island)*				
METALS				
	Reporting Limit (mg/kg)	DWL-30a1	DWL-30a2	RPD
Arsenic	1	4	4	0
Barium	1	110	110	0
Chromium (total)	1	20	20	0
Cobalt	0.4	8.5	8.8	3
Copper	1	22	22	0
Lead	1	20	17	16
Mercury	0.02	0.08	0.15	61
Nickel	1	24	24	0
Vanadium	0.4	32	ND	200
Zinc	4	190	32	142
AROMATIC & TOTAL PURGEABLE PETROLEUM HYDROCARBONS				
Toluene	0.013	0.016	0.018	12
Xylenes (total)	0.013	0.045	0.041	9

TABLE 26 *(continued)*

DUPLICATE SAMPLE ANALYSES *(Bouldin Island)*				
OTHER				
	Reporting Limit (mg/kg)	DWL-30a1	DWL-30a2	RPD
Oil and Grease	None	84,600	85,800	1

RPD = Relative Percent Difference = $[(D_1-D_2)/[(D_1+D_2)/2]]$ X 100
ND = None Detected
N/A = Not Applicable

The RPD for duplicate samples collected at Bouldin Island are well below 20. Only RPD values that exceed 20 are those for mercury, vanadium, and zinc. However, the detected concentrations for these three analytes, although elevated, are less than 100 times their respective instrument detection levels. According to the Method 6020 guidelines, the reporting difference is acceptable.

4.2 Equipment Blanks

Equipment blanks were collected at Holland Island and Webb Tract as another QA/QC measure to help check for possible contamination from the field equipment used to sample below the stain. This blank was collected by running deionized water over the sample auger. The rinseate was collected in a stainless steel bucket, and then poured through a stainless steel funnel into an amber glass bottle containing the appropriate preservative. These samples were analyzed for Title 22 heavy metals, including Chromium VI. No analytes were detected in the equipment blank samples.

4.3 Field Blanks

Four field blanks were collected as a QA/QC measure to check for possible contamination from sampling procedures and handling. Field blanks were collected by pouring deionized water into an amber glass bottle containing the appropriate preservative. Detection in this sample would indicate possible contamination of soil samples by the deionized water used throughout the sampling process, or contamination because of improper handling of samples. Samples were analyzed for aromatic and total purgeable petroleum hydrocarbons, which are some of the main ingredients in gasoline. No petroleum hydrocarbons were detected in any of the field blank samples.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following section discusses the conclusions and recommendations made by SAS staff based on the information obtained during the Phase I and Phase II investigations.

5.1 Stained Soil

Stained soils under and around equipment maintenance and storage facilities, fuel tanks, and oil storage tanks was observed and sampled. Laboratory results confirmed the presence of elevated levels of oil and grease. No other elements or compounds were detected at levels that exceeded established regulatory threshold values.

Based on the results of the Phase II ESA sampling, SAS recommends further investigation of the identified "hot spot" areas to better delineate the extent of contamination. Further investigation may include more invasive subsurface soil sampling, surface water and groundwater sampling, and environmental fate studies for each of the contaminants of concern. SAS also recommends that any contaminated soil at or near water supply well sites be removed and properly disposed of, or remediated, depending on the extent of contamination.

5.2 Gas Wells

SAS recommends that all measures be taken to indemnify the State from any liability associated with future hazardous substance contamination or remedial actions associated with the natural gas wells that are present throughout the Site. At this time, these gas wells and the parcels on which they are situated may not be part of the land acquisition for the Project. Such measures may include establishing baseline soil and groundwater sampling data for the properties surrounding the gas wells or inserting indemnification clauses in each of the proposed purchase agreements.

6.0 REFERENCES AND PERSONS CONSULTED

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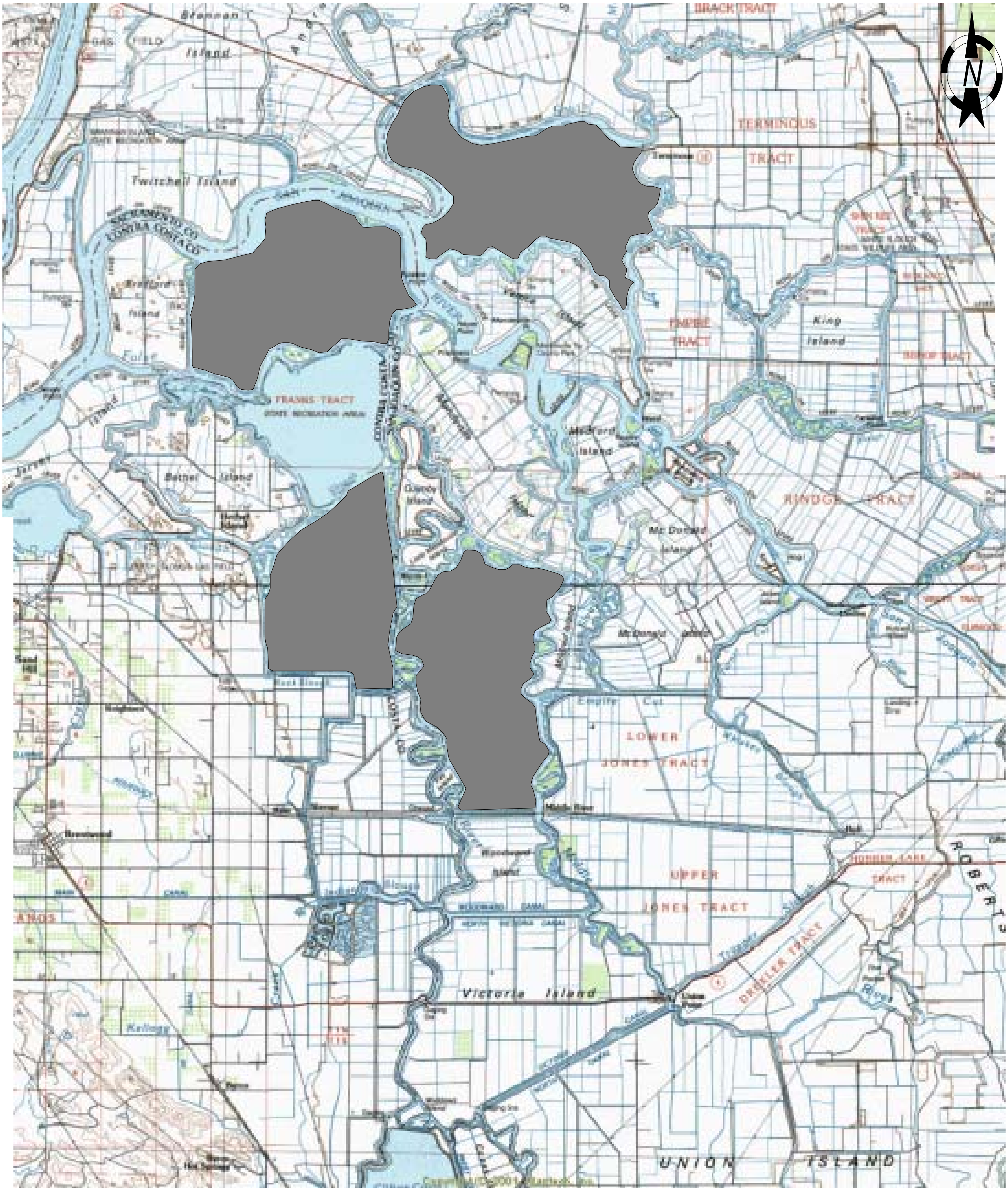
7.0 SIGNATURES

Prepared by:	Reviewed by:
James Gleim	Derrick J. Adachi, Chief
Environmental Scientist	Environmental Site Assessment Section
REA-07559	REA-06706

FIGURES



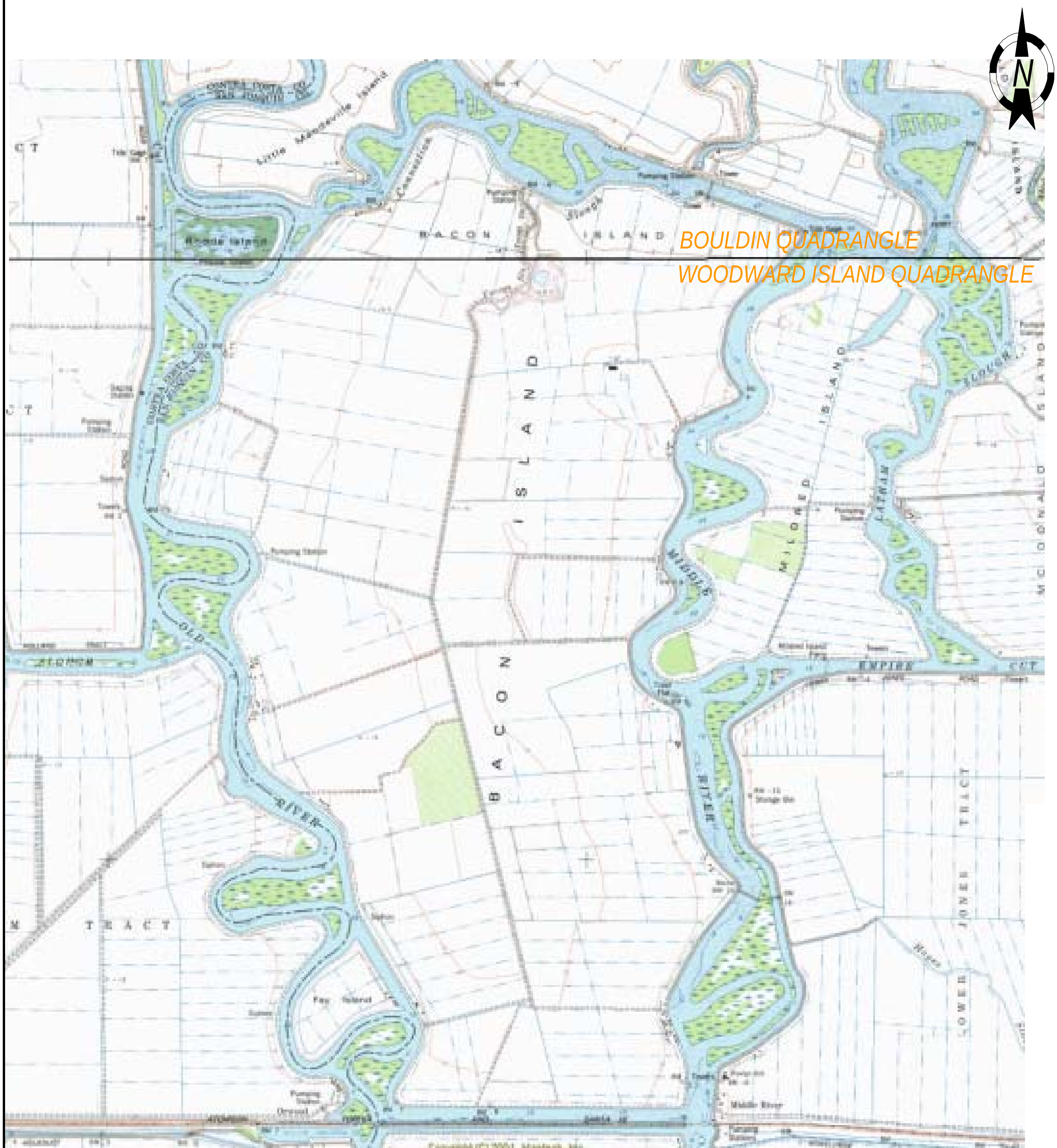
0 1 2 3 4

MILES

= APPROXIMATE SITE LOCATION

SOURCE:
30 x 60 USGS TOPOGRAPHIC MAP
STOCKTON and LODI, CALIFORNIA QUADRANGLES
1:100,000 SCALE

FIGURE 1
PROJECT SITE LOCATION



0 1/2 1

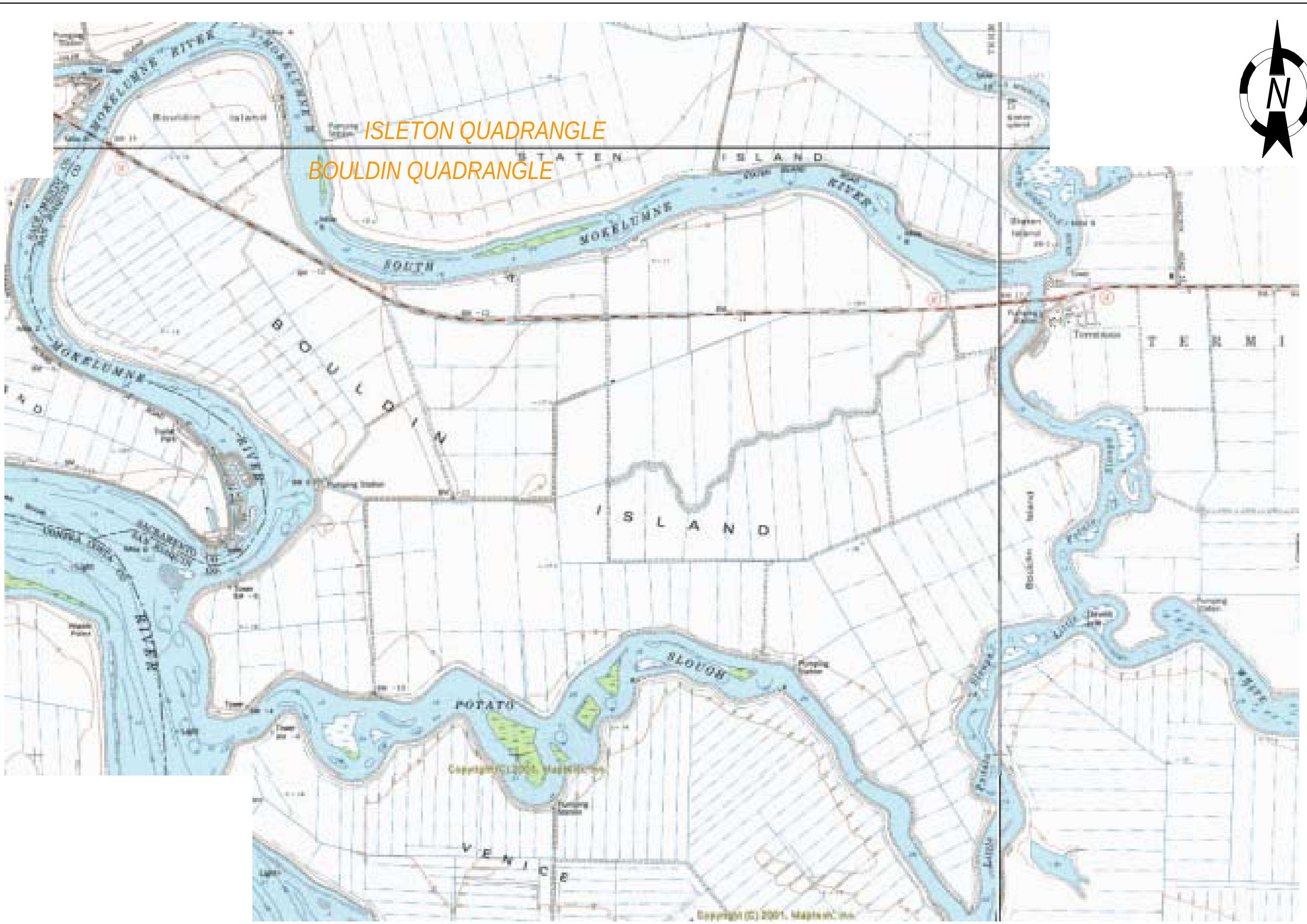
MILE

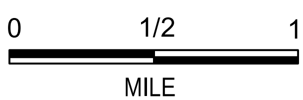
SITE

CALIF.

SOURCE:
7.5 MINUTE USGS TOPOGRAPHIC MAP
BOULDIN & WOODWARD ISLAND, CA. QUADRANGLES
1:24,000 SCALE

FIGURE 2
BACON ISLAND
SAN JOAQUIN COUNTY





SOURCE:
7.5 MINUTE USGS TOPOGRAPHIC MAP
BOULDIN, ISLETON, & TERMINOUS, CA. QUADRANGLES
1:24,000 SCALE

FIGURE 3
BOULDIN ISLAND
SAN JOAQUIN COUNTY, CALIFORNIA

0 1/2 1
MILE

SITE
CALIF.

SOURCE:
7.5 MINUTE USGS TOPOGRAPHIC MAP
BOULDIN & WOODWARD ISLAND, CA. QUADRANGLES
1:24,000 SCALE

FIGURE 4
HOLLAND TRACT
CONTRA COSTA COUNTY

0 1/2 1

MILE

SOURCE:
7.5 MINUTE USGS TOPOGRAPHIC MAP
BOULDIN & JERSEY ISLAND, CA. QUADRANGLES
1:24,000 SCALE

FIGURE 5
WEBB TRACT
CONTRA COSTA COUNTY, CALIFORNIA

APPENDIX A

SAMPLING PLAN
DELTA WETLANDS / IN-DELTA STORAGE

All sampling designed in this Sampling Plan is to obtain representative samples and is in accordance with procedures specified in "Test Methods for Evaluating Solid Waste, 3rd edition, SW-846, U.S. EPA, September 1986".

Background

The acquisition of four islands within the Sacramento/San Joaquin Delta is currently under consideration by DWR. The islands are Webb Tract, Bouldin Island, Holland Tract, and Bacon Island. It is proposed that two of the islands be flooded for water storage and two be used as mitigation land. This project is part of a comprehensive feasibility study associated with CALFED's Delta Wetlands Project.

The *modified* Phase I Environmental Site Assessment for the project site reported the presence of numerous waste oil drums and farm equipment maintenance areas. Many of such facilities had soil staining around them. Numerous water wells are at the Site which are potential conduits for groundwater contamination. It was recommended that the presence, nature, and extent of soil contamination be further investigated.

Objectives

The purpose of sampling at the site is to determine the presence or absence of contamination in the soil at the Site, and to make preliminary determinations regarding the nature and extent of any waste encountered. Soil samples will be collected to determine if any contaminants are present at concentrations exceeding regulatory threshold levels. Background samples will also be collected to determine the presence and concentration of any contaminants of concern in the general area surrounding the Site. Photographs will be taken to document the sampling event.

Personnel

Sampling will be conducted under the direction of Derrick J. Adachi, REA, Chief of the Site Assessment Section. Sampling will be performed by James W. Gleim, REA, Environmental Scientist Range C, Christopher Huitt, Environmental Scientist Range B, and Donald Guy, Environmental Scientist Range B.

Health and Safety

A Site Safety Plan for sampling activities was prepared and is included as Appendix A of this Sampling Plan. Appropriate personal protective equipment will be used to protect worker health and safety during the sampling event.

Rationale for Sampling Methods

A. **Number of Samples Collected**

DWR will collect a maximum of **130** soil samples from suspected areas of contamination surrounding the oil well facilities, above-ground storage tanks, and water pump facilities. A number of the soil samples will be collected from the same location, but from various depths. These samples will aid in determining the nature and extent of contamination.

B. Sampling Strategy

All samples collected for contaminant levels shall be done in accordance with the following requirements:

1. Grab Sampling:

Grab samples will be performed at the site, which dictates that the sampling and analysis of all samples collected should be identical so that bias is minimized. Soil samples will be collected at **0.5**, **2.0**, and **4.0** feet below ground surface. Samples will be collected at locations where soil contamination is suspected to be at the highest concentration within each individual area of concern.

(a) Sampling locations will be identified and recorded.
(b) Samples shall be collected using stainless steel spoons, a stainless steel shovel, and stainless steel hand or power auger flights, extensions, and bits. Each sample will be placed into a Level 2 pre-cleaned sample jar, sealed, labeled, and stored in a cooler with ice.
(c) All sampling equipment that was in direct contact with the soil shall be decontaminated prior to use at another sampling location.

2. Duplicates

As part of field QA/QC measures, **4**duplicate samples shall be collected. Where the number of duplicate samples is a fractional number, the number of duplicate samples collected shall be rounded up to the next whole number. The duplicate sample collected shall be submitted as a "blind duplicate." Sample identification numbers for the duplicate will be unique and indistinguishable from the other samples. The duplicate will be noted the field notebook for referencing in the report of analysis.

3. Equipment Blank

As part of field QA/QC measures, **2** equipment blank shall be collected on the same day as sample collection. The equipment blank shall be taken by rinsing lab grade deionized water on the sample collection equipment (shovel and spoon) and collecting this rinseate in a Level 2 precleaned sample container.

4. Travel Blank (NONE)

As part of field QA/QC measures, a travel blank will be obtained when the empty sample containers are picked up from E.S. Babcock and Sons, Inc. (Babcock), the certified analytical laboratory performing the analyses on the samples collected from the Site. This travel blank, consisting of sample containers filled
with deionized water by Babcock staff, will be placed in an ice chest upon receipt and will be kept with the collected samples for the duration of the sampling event. The travel blank will be submitted to Babcock along with the collected samples for analysis.

5. Background Samples

At least **7** background soil samples shall be collected at locations where the ground surface has not been farmed and is in a relatively natural and undisturbed state. The samples will be collect up-gradient from the Site. The background samples shall be taken at a depth of at least 3 inches below ground surface. Background samples shall be collected using the same equipment and methodology as all other samples. Background samples may be identified as such.

6. Sampling Methodology

   a. Equipment: Any combination of disposable plastic bags, a stainless steel shovel, stainless steel spoons, stainless steel hand auger, slide hammer, or power auger with its respective stainless steel extensions, flights, bits, and sampling sleeves will be used to collect samples.

   b. Decontamination: Reusable sampling equipment shall be cleaned prior to the collection of each sample. Decontamination shall be conducted by the following procedure:

      1. Shovels and spoons shall have gross contaminants removed by hand.
      2. Equipment shall be thoroughly washed with non-phosphate detergent and deionized water.
      3. Triple rinse with deionized water.

   c. Containers: All soil samples will be collected in 8-ounce borosilicate glass wide-mouth jars with Teflon closures. Water samples to be analyzed for Title 22 metals will be collected in 1-quart plastic containers preserved in advance with HNO_3. Water samples to be analyzed for pH will be collected in 1-quart plastic containers. Water samples to be analyzed for TPH will be collected in 1-liter amber glass jars with Teflon closures. Water samples to be analyzed for the volatile and semi-volatile organics scan will be collected in 2-liter amber glass jars with Teflon closures. Water samples to be analyzed for volatile organic compounds will be collected in two duplicate 40-ml amber glass vials with Teflon closures preserved in advance with HCl. Water samples to be analyzed for carbamate pesticides will be collected in 1-liter amber glass jars with Teflon closures. Care will be exercised to avoid cross-contamination from equipment or gloves.

   d. Duplicates: Samples will be collected following this procedure:

      ? placing a collected soil sample into a new disposable plastic bag
      ? homogenizing the sample by hand
      ? dividing the sample into two sample jars

7. Chain of Custody

   All samples will be sealed and labeled upon collection. The sample number, date, time, location and name of the sampler will be recorded. In addition, the samples will be entered on Chain of Custody forms before delivery to the laboratory. The samples will be stored and transported in a container cooled with ice packs. The cooler containing the samples and Chain of Custody will be delivered to Babcock, a certified analytical laboratory.

C. Analysis

Samples collected will undergo the following analyses:

SAMPLE ANALYSIS	METHOD
pH	EPA Method 9045C
TTLC - Title 22 Metals+	EPA Methods 6010B/7471A/200.7
BTEX & MTBE (Benzene, Toluene, Ethylbenzene, Xylene)	EPA Method 8260
Oil/Grease	EPA Method 1664
Organochlorine Pestcides	EPA Method 8081A
Polychlorinated Biphenyls	EPA Method 8082
Polynuclear Aromatic Hydrocarbons	EPA Method 8100
Organophosphorous Compounds	EPA Method 8141A
Polyaeromatic Hydrocarbons	EPA Method 8015/8020A
Semivolatile Organic Compounds	EPA Method 8270

+ [17] Title 22 Metals plus Hexavalent Cr (VI)
[Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Se, Ag, Tl, V, Zn]

After initial results are received, DWR may request that the following analysis be performed on the samples collected:

SAMPLE ANALYSIS	METHOD
STLC - Waste Extraction Test ++	EPA Method 6010/6020 (for metals only) +++

++ Waste Extraction Test for metals - Title 22 CCR, Div 4.5, Chapter 11, Appendix 2, Section 66261.126 et al

+++ As a general rule, total concentrations of a metal that exceed 10 times the STLC have the potential to exceed the Soluble Threshold Limit Concentration. Appropriate and equivalent analytical methods may be substituted as necessary by the analytical laboratory.

References

Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., November 1986, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, D.C..

HML Users Manual, October 1990, California Department of Health Services, Hazardous Materials Laboratory, Berkeley, CA.

Statistical Analysis of Ground-Water Monitoring Data At RCRA Facilities, Interim Final Guidance, April 1989, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, D.C..

Preliminary Endangerment Assessment Guidance Manual (A guidance manual for evaluating hazardous substance release sites.), January 1994, California Department of Toxic Substance Control, Sacramento, CA.

APPENDIX B

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

METALS

Analyte	Reporting Limit (Soil) (mg/kg)	Reporting Limit (Water) (mg/L)	TTLC* for Metals (mg/kg)	DWB-22a (mg/kg)	DWB-22ah (mg/kg)	DWB-23a (mg/kg)	DWB-23ah (mg/kg)	DWB-24b1 (mg/kg)	DWB-24bh1 (mg/kg)	DWB-24b2 (mg/kg)	DWB-24bh2 (mg/kg)	DWB-25a (mg/kg)	DWB-25ah (mg/kg)	DWB-25b (mg/L)	DWB-25bh (mg/L)
Antimony	2	0.006	500	ND		ND		ND		ND		ND		ND	
Arsenic	1	0.002	500	**6**		**11**		**4**		**5**		**8**		**14**	
Barium	1	0.1	10,000	**130**		**150**		**42**		**50**		**120**		**82**	
Beryllium	0.2	0.001	75	ND		ND		ND		ND		ND		ND	
Cadmium	0.2	0.001	1000	ND		ND		ND		ND		ND		ND	
Hexavalent Chromium	0.5	0.01			ND		ND		ND		ND		ND		ND
Total Chromium	1	0.01	2,500	**31**		**33**		**6**		**6**		**26**		**12**	
Cobalt	0.4	0.01	8,000	**9**		**10**		**1.6**		**1.7**		**8.3**		**6.9**	
Copper	1	0.01	2,500	**21**		**25**		**4**		**4**		**20**		**9**	
Lead	1	0.005	1,000	**12**		**19**		**1**		**2**		**16**		**3**	
Mercury	0.02	0.001	20	**0.03**		**0.08**		ND		ND		**0.05**		**0.03**	
Molybdenum	1	0.01	3,500	**2**		**3**		**3**		**3**		**2**		**5**	
Nickel	1	0.01	2,000	**39**		**46**		**9**		**10**		**41**		**24**	
Selenium	2	0.005	100	ND		ND		ND		ND		ND		ND	
Silver	0.6	0.01	500	ND		ND		ND		ND		ND		ND	
Thallium	2	0.001	700	ND		ND		ND		ND		ND		ND	
Vanadinium	0.4	0.01	2,400	**47**		**52**		**11**		**13**		**44**		**29**	
Zinc	4	0.01	5,000	**55**		**160**		**5**		**7**		**240**		**19**	

Analyte	DWB-26a (mg/L)	DWB-26ah (mg/kg)	DWB-26b (mg/kg)	DWB-26bh (mg/kg)	DWB-27a (mg/kg)	DWB-27ah (mg/kg)	DWB-28a (mg/kg)	DWB-28ah (mg/kg)	DWB-28b1 (mg/kg)	DWB-28bh1 (mg/kg)	DWB-28b2 (mg/kg)	DWB-28bh2 (mg/kg)	DWB-29a (mg/kg)	DWB-29ah (mg/kg)	DWB-29b (mg/kg)	DWB-29bh (mg/kg)	DWB-29EB (mg/kg)
Antimony	ND		ND		ND		ND		ND		ND		ND		ND		
Arsenic	**12**		**3**		**10**		**8**		**5**		**4**		**5**		**11**		
Barium	**120**		**28**		**140**		**250**		**110**		**110**		**130**		**120**		
Beryllium	ND		ND		**0.5**		ND		ND		ND		ND		ND		
Cadmium	ND		ND		ND		**0.05**		ND		ND		ND		ND		
Hexavalent Chromium		ND		ND		ND		ND		ND		ND		ND		ND	ND
Total Chromium	**22**		**3**		**37**		**12**		**27**		**26**		**19**		**24**		
Cobalt	**4.8**		**1.2**		**8.9**		**38**		**7.8**		**7.7**		**5.3**		**5.5**		
Copper	**20**		**2**		**29**		**96**		**22**		**22**		**130**		**27**		
Lead	**9**		**1**		**270**		**0.06**		**15**		**14**		**52**		**17**		
Mercury	**0.03**		ND		**0.1**		**5**		**0.06**		**0.06**		**0.05**		**0.07**		
Molybdenum	**4**		**1**		**3**		**39**		**2**		**1**		**3**		**4**		
Nickel	**26**		**6**		**42**		ND		**29**		**29**		**23**		**24**		
Selenium	ND		ND		ND		ND		ND		ND		ND		ND		
Silver	ND		ND		ND		ND		ND		ND		ND		ND		
Thallium	ND		ND		ND		ND		ND		ND		ND		ND		
Vanadinium	**44**		**7.3**		**60**		**31**		**42**		**41**		**24**		**46**		
Zinc	**55**		**7**		**53**		**290**		**280**		**270**		**520**		**43**		

ND: None Detected at Reporting Limit

mg/kg: millligrams/kilogram = parts per million

µg/L: micrograms/liter = parts per billion

*Total Threshold Limit Concentration given in Title 22 California Code of Regulations, secion 66261.24

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

pH, Chlorinated Pesticides, PCBs, PAH, Oil & Grease

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)
pH	-	5		4.6		4.4		4.2		4.6		3.8		6.4		6.2		3.9		5.1		5.5		5.6		5.4		4.8		

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
CHLORINATED PESTICIDES	(mg/kg)																													
Aldrin	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
alpha-BHC	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
beta-BHC	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
gamma-BHC (Lindane)	0.3	ND		**0.32**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
delta-BHC	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Chlordane	0.6	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
p,p'-DDD	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
p,p'-DDE	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**0.01**		
p,p'-DDT	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Dieldrin	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Endosulfan	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Endosulfan II	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Endosulfan Sulfate	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Endrin	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Endrin Aldehyde	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Endrin Ketone	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Heptachlor	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Heptachlor Epoxide	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Methoxychlor	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Toxaphene	0.0	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Surrogate TCMX		NC		105 (%)		77 (%)		83 (%)		NC		NC		89 (%)		65 (%)		NC		NC		91 (%)		101 (%)		NC		80 (%)		
Surrogate Decachlorobiphenyl		NC		NC		26 (%)		26 (%)		NC		NC		36 (%)		21 (%)		NC		NC		NC		50 (%)		NC		40 (%)		

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
POLYCHLORINATED BEPHENYLS																														
PCB 1016	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
PCB 1221	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
PCB 1232	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
PCB 1242	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
PCB 1248	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
PCB 1254	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
PCB 1260	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Surrogate TCMX		73 (%)		79 (%)		39 (%)		93 (%)		65 (%)		42 (%)		92 (%)		62 (%)		NC		76 (%)		75 (%)		82 (%)		NC		79 (%)		
Surrogate Decachlorobiphenyl		79 (%)		36 (%)		43 (%)		86 (%)		90 (%)		35 (%)		84 (%)		56 (%)		NC		112 (%)		87 (%)		75 (%)		21 (%)		67 (%)		

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
AROMATC & TOTAL PURGEABLE PETROLEUM HYDROCARBONS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Benzene	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Toluene	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Ethylbenzene	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Xylenes (Total)	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**0.10**		**0.16**		ND		ND		
Methyl tert-Butyl Ether (MTBE)	0.63	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Surrogate 4-BFB (FID)		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Surrogate 4-BFB (PID)		62 (%)		58 (%)		70 (%)		69 (%)		59 (%)		64 (%)		67 (%)		99 (%)		67 (%)		57 (%)		122 (%)		131 (%)		68 (%)		72 (%)		

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Oil & Grease	1000		**10,200**		**28,300**		**144**		**132**		**195,000**		**126**		**291**		**54**		**17,800**		**296,000**		**35,500**		**35,300**		**89,400**		**2,490**	

TPH: Total Petroleum Hydrocarbons
ND: None Detected at Reporting Limit
NC: A result could not be calculated due to matrix interference.
mg/kg: milligrams/kilogram = parts per million
µg/L: micrograms/liter = parts per billion
*Reporting Limit - 10 mg/kg

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

Organophosphorus Pesticides & Semivolitile Organic Compounds

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
ORGANOPHOSPHORUS PESTICIDES																														
Chlorpyrifos (Dursban)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Coumaphos	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Demeton (O & S)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Diazinon	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Dichlorvos	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Disulfoton (Di-Syston)	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Ethoprophos (Prophos)	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Fensulfothion	10	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Fenthion	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Azinphos methy (Guthion)	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Merphos	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Parathion methyl	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Naled (Dibrom)	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Phorate (Thimet)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Mevinphos (Phosdrin)	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Ronnel (Fenchlorophos)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Bolstar (Sulprofos)	10	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Stirophos (Tetrachlorvinphos)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Tokuthion (Prothiofos)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Trichloronate	10	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Surrogate-Tributylphosphate		342 (%)		97 (%)		77 (%)		90 (%)		355 (%)		NC		91 (%)		68 (%)		316 (%)		636 (%)		356 (%)		350 (%)		366 (%)		179 (%)		
Surrogate-Triphenylphosphate		72 (%)		121 (%)		60 (%)		75 (%)		131 (%)		NC		83 (%)		44 (%)		NC		1,270 (%)		133 (%)		126 (%)		105 (%)		79 (%)		

Analyte	Reporting Limit (soil)	DWB-22a	DWB-22ah	DWB-23a	DWB-23ah	DWB-24b1	DWB-24bh1	DWB-24b2	DWB-24bh2	DWB-25a	DWB-25ah	DWB-25b	DWB-25bh	DWB-26a	DWB-26ah	DWB-26b	DWB-26bh	DWB-27a	DWB-27ah	DWB-28a	DWB-28ah	DWB-28b1	DWB-28bh1	DWB-28b2	DWB-28bh2	DWB-29a	DWB-29ah	DWB-29b	DWB-29bh	DWB-29EB
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
SEMIVOLATILE ORGANIC COMPOUNDS																														
Acenaphtene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Acenaphthylene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Anthracene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Benzo(a)anthracene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Benzo(b)fluoranthene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Benzo(k)fluoranthene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Benzo(ghi)perylene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Benzo(a)pyrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Chrysene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Dibenzo(a,h)anthracene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Fluoranthene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Fluorene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Indeno(1,2,3-cd)pyrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Napthalene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Phenanthrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Pyrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		
Surrogate Nitrobenzene-d5		85 (%)		74 (%)		73 (%)		81 (%)		77 (%)		67 (%)		79 (%)		85 (%)		84 (%)		84 (%)		112 (%)		187 (%)		95 (%)		86 (%)		
Surrogate 2-Fuorobiphenyl		120 (%)		101 (%)		80 (%)		94 (%)		132 (%)		90 (%)		85 (%)		84 (%)		121 (%)		135 (%)		129 (%)		251 (%)		143 (%)		93 (%)		
Surrogate Terphenyl-d14		84 (%)		77 (%)		77 (%)		2 (%)		93 (%)		70 (%)		79 (%)		78 (%)		78 (%)		97 (%)		87 (%)		155 (%)		111 (%)		9 (%)		
Surrogate 2-Fuorophenol		68 (%)		61 (%)		63 (%)		65 (%)		71 (%)		54 (%)		59 (%)		63 (%)		77 (%)		71 (%)		66 (%)		144 (%)		76 (%)		65 (%)		
Surrogate Phenol-d6		86 (%)		73 (%)		73 (%)		76 (%)		85 (%)		67 (%)		74 (%)		79 (%)		94 (%)		88 (%)		91 (%)		185 (%)		88 (%)		82 (%)		
Surrogate 2,4,6-Tribromophenol		92 (%)		69 (%)		93 (%)		88 (%)		65 (%)		67 (%)		5 (%)		96 (%)		99 (%)		55 (%)		77 (%)		55 (%)		101 (%)		85 (%)		

TPH: Total Petroleum Hydrocarbons
ND: None Detected at Reporting Limit
NC: A result could not be calculated due to matrix interference.
mg/kg: millligrams/kilogram = parts per million
µg/L: micrograms/liter = parts per billion
*Reporting Limit - 10 mg/kg

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

METALS

Analyte	Reporting Limit (Soil) (mg/kg)	Reporting Limit (Water) (mg/L)	TTLC* for Metals (mg/kg)	DWL-FB3 (mg/kg)	DWL-FB4 (mg/kg)	DWL-30a1 (mg/kg)	DWL-30ah1 (mg/kg)	DWL-30a2 (mg/kg)	DWL-30ah2 (mg/kg)	DWL-30b (mg/kg)	DWL-30bh (mg/kg)	DWL-30c (mg/kg)	DWL-30ch (mg/kg)	DWL-31a (mg/L)	DWL-31ah (mg/L)	DWL-32a (mg/L)	DWL-32ah (mg/kg)	DWL-32EB (mg/kg)	LAB BLANK
Antimony	2	0.006	500			ND		ND		ND		ND		ND		ND			
Arsenic	1	0.002	500			4		4		6		2		14		4			
Barium	1	0.1	10,000			110		110		140		58		170		130			
Beryllium	0.2	0.001	75			ND		ND		ND		ND		ND		ND			
Cadmium	0.2	0.001	1000			ND		ND		0.8		ND		ND		ND			
Hexavalent Chromium	0.5	0.01					ND		ND		ND		ND		ND		ND		ND
Total Chromium	1	0.01	2,500			20		20		20		7		38		17		ND	
Cobalt	0.4	0.01	8,000			8.5		8.8		6.8		3.8		13		8.1			
Copper	1	0.01	2,500			22		22		19		5		26		38			
Lead	1	0.005	1,000			20		17		8		2		10		52			
Mercury	0.02	0.001	20			0.08		0.15		0.08		ND		0.07		0.06			
Molybdenum	1	0.01	3,500			ND		ND		ND		ND		1		17			
Nickel	1	0.01	2,000			24		24		21		11		46		17			
Selenium	2	0.005	100			ND		ND		ND		ND		ND		ND			
Silver	0.6	0.01	500			ND		ND		ND		ND		ND		ND			
Thallium	2	0.001	700			ND		ND		ND		ND		ND		ND			
Vanadinium	0.4	0.01	2,400			32		ND		31		17		56		38			
Zinc	4	0.01	5,000			190		32		310		17		61		210			

ND: None Detected at Reporting Limit

mg/kg: milligrams/kilogram = parts per million

µg/L: micrograms/liter = parts per billion

*Total Threshold Limit Concentration given in Title 22 California Code of Regulations, secion 66261.24

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

pH, Chlorinated Pesticides, PCBs, PAH, Oil & Grease

Analyte	Reporting Limit (soil)	DWL-FB3	DWL-FB4	DWL-30a1	DWL-30ah1	DWL-30a2	DWL-30ah2	DWL-30b	DWL-30bh	DWL-30c	DWL-30ch	DWL-31a	DWL-31ah	DWL-32a	DWL-32ah	DWL-32EB
	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)
pH	-			5.8		5.8		5.6		6.6		6		6.2		

Analyte	Reporting Limit (soil)	DWL-FB3	DWL-FB4	DWL-30a1	DWL-30ah1	DWL-30a2	DWL-30ah2	DWL-30b	DWL-30bh	DWL-30c	DWL-30ch	DWL-31a	DWL-31ah	DWL-32a	DWL-32ah	DWL-32EB
CHLORINATED PESTICIDES	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aldrin	0.3			ND		ND		ND		ND		ND		ND		
alpha-BHC	0.3			ND		ND		ND		ND		ND		ND		
beta-BHC	0.3			ND		ND		ND		ND		ND		ND		
gamma-BHC (Lindane)	0.3			ND		ND		ND		ND		ND		ND		
delta-BHC	0.3			ND		ND		ND		ND		ND		ND		
Chlordane	0.6			ND		ND		ND		ND		ND		ND		
p,p'-DDD	0.3			ND		ND		ND		ND		**0.049**		ND		
p,p'-DDE	0.3			ND		ND		ND		ND		**0.17**		ND		
p,p'-DDT	0.3			ND		ND		ND		ND		**0.089**		ND		
Dieldrin	0.3			ND		ND		ND		ND		**0.15**		ND		
Endosulfan	0.3			ND		ND		ND		ND		ND		ND		
Endosulfan II	0.3			ND		ND		ND		ND		ND		ND		
Endosulfan Sulfate	0.3			ND		ND		ND		ND		ND		ND		
Endrin	0.3			ND		ND		ND		ND		ND		ND		
Endrin Aldehyde	0.3			ND		ND		ND		ND		ND		ND		
Endrin Ketone	0.3			ND		ND		ND		ND		ND		ND		
Heptachlor	0.3			ND		ND		ND		ND		ND		ND		
Heptachlor Epoxide	0.3			ND		ND		ND		ND		ND		ND		
Methoxychlor	0.3			ND		ND		ND		ND		ND		ND		
Toxaphene	0.0			ND		ND		ND		ND		ND		ND		
Surrogate TCMX				NC		139 (%)		NC		113 (%)		117 (%)		NC		
Surrogate Decachlorobiphenyl				NC		NC		NC		NC		165 (%)		287 (%)		

Analyte	Reporting Limit (soil)	DWL-FB3	DWL-FB4	DWL-30a1	DWL-30ah1	DWL-30a2	DWL-30ah2	DWL-30b	DWL-30bh	DWL-30c	DWL-30ch	DWL-31a	DWL-31ah	DWL-32a	DWL-32ah	DWL-32EB
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)
POLYCHLORINATED BEPHENYLS																
PCB 1016	0.04			ND		ND		ND		ND		ND		ND		
PCB 1221	0.04			ND		ND		ND		ND		ND		ND		
PCB 1232	0.04			ND		ND		ND		ND		ND		ND		
PCB 1242	0.04			ND		ND		ND		ND		ND		ND		
PCB 1248	0.04			ND		ND		ND		ND		ND		ND		
PCB 1254	0.04			ND		ND		ND		ND		ND		ND		
PCB 1260	0.04			ND		ND		ND		ND		ND		ND		
Surrogate TCMX				51 (%)		58 (%)		48 (%)		59 (%)		70 (%)		109 (%)		
Surrogate Decachlorobiphenyl				100 (%)		89 (%)		99 (%)		92 (%)		44 (%)		98 (%)		

Analyte	Reporting Limit (soil)	DWL-FB3	DWL-FB4	DWL-30a1	DWL-30ah1	DWL-30a2	DWL-30ah2	DWL-30b	DWL-30bh	DWL-30c	DWL-30ch	DWL-31a	DWL-31ah	DWL-32a	DWL-32ah	DWL-32EB
AROMATC & TOTAL PURGEABLE PETROLEUM HYDROCARBONS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)
Benzene	0.013	ND	ND	ND		ND		ND		ND		ND		ND		
Toluene	0.013	ND	ND	**0.016**		**0.018**		ND		**0.016**		ND		ND		
Ethylbenzene	0.013	ND	ND	ND		ND		ND		**0.057**		ND		ND		
Xylenes (Total)	0.013	ND	ND	**0.045**		**0.041**		**0.12**		**0.43**		ND		ND		
Methyl tert-Butyl Ether (MTBE)	0.63	ND	ND	ND		ND		ND		ND		ND		ND		
Surrogate 4-BFB (FID)		93 (%)	86 (%)	ND		ND		ND		ND		ND		ND		
Surrogate 4-BFB (PID)		84 (%)	81 (%)	140 (%)		144 (%)		133 (%)		146 (%)		68 (%)		68 (%)		

Analyte	Reporting Limit (soil)	DWL-FB3	DWL-FB4	DWL-30a1	DWL-30ah1	DWL-30a2	DWL-30ah2	DWL-30b	DWL-30bh	DWL-30c	DWL-30ch	DWL-31a	DWL-31ah	DWL-32a	DWL-32ah	DWL-32EB	LAB BLANK
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	
Oil & Grease	1000				**84,600**		**85,800**		**84,000**		**52,300**		ND		**112,000**		ND

TPH: Total Petroleum Hydrocarbons

ND: None Detected at Reporting Limit

NC: A result could not be calculated due to matrix interference.

mg/kg: millligrams/kilogram = parts per million

µg/L: micrograms/liter = parts per billion

+Reporting Limit - 10 mg/kg

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

Organophosphorus Pesticides & Semivolitile Organic Compounds

Analyte	Reporting Limit (soil) (mg/kg)	DWL-FB3 (mg/kg)	DWL-FB4 (mg/kg)	DWL-30a1 (mg/kg)	DWL-30ah1 (mg/kg)	DWL-30a2 (mg/kg)	DWL-30ah2 (mg/kg)	DWL-30b (mg/kg)	DWL-30bh (mg/kg)	DWL-30c (mg/kg)	DWL-30ch (mg/kg)	DWL-31a (mg/kg)	DWL-31ah (mg/kg)	DWL-32a (mg/kg)	DWL-32ah (mg/kg)	DWL-32EB (mg/kg)
ORGANOPHOSPHORUS PESTICIDES																
Chlorpyrifos (Dursban)	4			ND		ND		ND		ND		ND		ND		
Coumaphos	20			ND		ND		ND		ND		ND		ND		
Demeton (O & S)	4			ND		ND		ND		ND		ND		ND		
Diazinon	4			ND		ND		ND		ND		ND		ND		
Dichlorvos	4			ND		ND		ND		ND		ND		ND		
Disulfoton (Di-Syston)	70			ND		ND		ND		ND		ND		ND		
Ethoprophos (Prophos)	70			ND		ND		ND		ND		ND		ND		
Fensulfothion	10			ND		ND		ND		ND		ND		ND		
Fenthion	4			ND		ND		ND		ND		ND		ND		
Azinphos methy (Guthion)	20			ND		ND		ND		ND		ND		ND		
Merphos	20			ND		ND		ND		ND		ND		ND		
Parathion methyl	70			ND		ND		ND		ND		ND		ND		
Naled (Dibrom)	70			ND		ND		ND		ND		ND		ND		
Phorate (Thimet)	4			ND		ND		ND		ND		ND		ND		
Mevinphos (Phosdrin)	20			ND		ND		ND		ND		ND		ND		
Ronnel (Fenchlorophos)	4			ND		ND		ND		ND		ND		ND		
Bolstar (Sulprofos)	10			ND		ND		ND		ND		ND		ND		
Stirophos (Tetrachlorvinphos)	4			ND		ND		ND		ND		ND		ND		
Tokuthion (Prothiofos)	4			ND		ND		ND		ND		ND		ND		
Trichloronate	10			ND		ND		ND		ND		ND		ND		
Surrogate-Tributylphosphate				NC		NC		NC		93 (%)		156 (%)		353 (%)		
Surrogate-Triphenylphosphate				494 (%)		500 (%)		502 (%)		88 (%)		45 (%)		62 (%)		

Analyte	Reporting Limit (soil) (mg/kg)	DWL-FB3 (mg/kg)	DWL-FB4 (mg/kg)	DWL-30a1 (mg/kg)	DWL-30ah1 (mg/kg)	DWL-30a2 (mg/kg)	DWL-30ah2 (mg/kg)	DWL-30b (mg/kg)	DWL-30bh (mg/kg)	DWL-30c (mg/kg)	DWL-30ch (mg/kg)	DWL-31a (mg/kg)	DWL-31ah (mg/kg)	DWL-32a (mg/kg)	DWL-32ah (mg/kg)	DWL-32EB (mg/kg)
SEMIVOLATILE ORGANIC COMPOUNDS																
Acenaphtene	50			ND		ND		ND		ND		ND		ND		
Acenaphthylene	50			ND		ND		ND		ND		ND		ND		
Anthracene	50			ND		ND		ND		ND		ND		ND		
Benzo(a)anthracene	50			ND		ND		ND		ND		ND		ND		
Benzo(b)fluoranthene	50			ND		ND		ND		ND		ND		ND		
Benzo(k)fluoranthene	50			ND		ND		ND		ND		ND		ND		
Benzo(ghi)perylene	50			ND		ND		ND		ND		ND		ND		
Benzo(a)pyrene	50			ND		ND		ND		ND		ND		ND		
Chrysene	50			ND		ND		ND		ND		ND		ND		
Dibenzo(a,h)anthracene	50			ND		ND		ND		ND		ND		ND		
Fluoranthene	50			ND		ND		ND		ND		ND		ND		
Fluorene	50			ND		ND		ND		ND		ND		ND		
Indeno(1,2,3-cd)pyrene	50			ND		ND		ND		ND		ND		ND		
Napthalene	50			ND		ND		ND		ND		ND		ND		
Phenanthrene	50			ND		ND		ND		ND		ND		ND		
Pyrene	50			ND		ND		ND		ND		ND		ND		
Surrogate Nitrobenzene-d5				103 (%)		90 (%)		89 (%)		86 (%)		83 (%)		94 (%)		
Surrogate 2-Fuorobiphenyl				143 (%)		115 (%)		108 (%)		110 (%)		87 (%)		137 (%)		
Surrogate Terphenyl-d14				75 (%)		60 (%)		64 (%)		61 (%)		67 (%)		94 (%)		
Surrogate 2-Fuorophenol				74 (%)		73 (%)		73 (%)		74 (%)		64 (%)		76 (%)		
Surrogate Phenol-d6				94 (%)		86 (%)		86 (%)		85 (%)		77 (%)		89 (%)		
Surrogate 2,4,6-Tribromophenol				65 (%)		69 (%)		74 (%)		65 (%)		92 (%)		97 (%)		

TPH: Total Petroleum Hydrocarbons

ND: None Detected at Reporting Limit

NC: A result could not be calculated due to matrix interference.

mg/kg: millligrams/kilogram = parts per million

μg/L: micrograms/liter = parts per billion

$^{+}$Reporting Limit - 10 mg/kg

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

METALS

Analyte	Reporting Limit (Soil) (mg/kg)	Reporting Limit (Water) (mg/L)	TTLC* for Metals (mg/kg)	DWH-1a (mg/kg)	DWH-1ah (mg/kg)	DWH-1b (mg/kg)	DWH-1bh (mg/kg)	DWH-2a (mg/kg)	DWH-2ah (mg/kg)	DWH-2b (mg/kg)	DWH-2bh (mg/kg)	DWH-3a (mg/kg)	DWH-3ah (mg/kg)	DWH-3b (mg/L)	DWH-3bh (mg/L)	DWH-4a (mg/L)	DWH-4ah (mg/kg)	DWH-4b (mg/kg)	DWH-4bh (mg/kg)	DWH-5a (mg/kg)	DWH-5ah (mg/kg)	DWH-5b (mg/kg)	DWH-5bh (mg/kg)	DWH-6a (mg/kg)	DWH-6ah (mg/kg)	DWH-6b1 (mg/kg)	DWH-6bh1 (mg/L)	DWH-6b2 (mg/kg)	DWH-6bh2 (mg/kg)	DWH-7a (mg/kg)	DWH-7ah (mg/kg)	DWH-7b (mg/kg)	DWH-7bh (mg/kg)	DWH-8a (mg/kg)	DWH-8ah (mg/kg)	DWH-8b1 (mg/kg)	DWH-8bh1 (mg/kg)	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah	DWH-EB
Antimony	2	0.006	500	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Arsenic	1	0.002	500	3		6		2		4		2		1		2		3		3		3		3		ND		ND		2		2		2		1		2		3		2		2		ND
Barium	1	0.1	10,000	44		86		28		70		25		27		30		35		41		36		47		18		19		36		19		39		28		27		36		24		33		ND
Beryllium	0.2	0.001	75	0.2		0.3		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Cadmium	0.2	0.001	1000	1.3		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.9		ND		ND		ND		ND		ND		ND
Hexavalent Chromium	1	0.01			ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Total Chromium	1	0.01	2,500	13		23		9		17		9		11		9		10		10		11		11		11		11		9		9		10		11		10		10		8		7		ND
Cobalt	0.4	0.01	8,000	3.2		6.3		2.6		3.8		2.3		3.6		2.5		2.5		2.5		2.8		2.2		2.2		2.3		2.5		2.7		2.3		2.3		2.2		2.8		2.5		2		ND
Copper	1	0.01	2,500	10		29		4		16		3		4		3		4		8		4		14		3		3		11		4		8		3		3		5		5		3		ND
Lead	1	0.005	1,000	20		31		3		18		2		2		8		3		8		4		13		2		2		16		3		9		3		3		3		2		2		ND
Mercury	0.02	0.001	20	ND		0.04		ND		0.03		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Molybdenum	1	0.01	3,500	2		4		ND		3		ND		ND		ND		1		1		ND		2		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Nickel	1	0.01	2,000	13		23		10		19		9		13		10		11		11		12		10		9		10		10		10		10		10		10		11		10		9		ND
Selenium	2	0.005	100	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Silver	0.6	0.01	500	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Thallium	2	0.001	700	16		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
Vanadinium	0.4	0.01	2,400	530		36		13		30		12		18		13		15		13		15		10		17		18		11		13		12		13		13		15		12		11		ND
Zinc	4	0.01	5,000	4.6		310		35		68		15		11		35		9		290		45		360		12		10		200		13		43		11		11		16		13		11		ND

ND: None Detected at Reporting Limit

mg/kg: millligrams/kilogram = parts per million

μg/L: micrograms/liter = parts per billion

*Total Threshold Limit Concentration given in Title 22 California Code of Regulations, secion 66261.24

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

pH, Chlorinated Pesticides, PCBs, PAH, Oil & Grease

Analyte	Reporting Limit (soil)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah
	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)									
pH	-	4.6		6.4		6.1		5.5		7.6		7.7		7.1		7.6		6.5		7.8		6.5		8.0		8		5.5		7.4		7		7.9		8		6.9		6.7		7.1	

Analyte	Reporting Limit (soil)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah
CHLORINATED PESTICIDES	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aldrin	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
alpha-BHC	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
beta-BHC	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
gamma-BHC (Lindane)	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
delta-BHC	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Chlordane	0.012	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
p,p'-DDD	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
p,p'-DDE	0.150	ND		**0.045**		ND		**0.35**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
p,p'-DDT	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**0.036**		ND		ND		ND		ND		ND	
Dieldrin	0.150	ND		**0.34**		ND		**1.5**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endosulfan	0.006	ND		ND		ND		ND		ND		ND		**0.165**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endosulfan II	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endosulfan Sulfate	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endrin	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endrin Aldehyde	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endrin Ketone	0.006	ND		ND		ND		**0.022**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Heptachlor	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Heptachlor Epoxide	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Methoxychlor	0.006	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Toxaphene	0.040	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Surrogate TCMX		101 (%)		116 (%)		101 (%)		100 (%)		NC		48 (%)		81 (%)		97 (%)		107 (%)		74 (%)		470 (%)		110 (%)		91 (%)		770 (%)		114 (%)		104 (%)		105 (%)		98 (%)		82 (%)		79 (%)		102 (%)	
Surrogate Decachlorobiphenyl		92 (%)		108 (%)		98 (%)		128 (%)		48 (%)		46 (%)		199 (%)		89 (%)		NC		82 (%)		NC		67 (%)		78 (%)		NC		57 (%)		88 (%)		97 (%)		100 (%)		56 (%)		61 (%)		98 (%)	

Analyte	Reporting Limit (soil)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
POLYCHLORINATED BEPHENYLS																																											
PCB 1016	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCB 1221	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCB 1232	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCB 1242	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCB 1248	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCB 1254	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCB 1260	0.02	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Surrogate TCMX		87 (%)		82 (%)		85 (%)		78 (%)		26 (%)		88 (%)		102 (%)		103 (%)		72 (%)		64 (%)		71 (%)		63 (%)		63 (%)		44 (%)		70 (%)		69 (%)		63 (%)		67 (%)		57 (%)		56 (%)		65 (%)	
Surrogate Decachlorobiphenyl		97 (%)		95 (%)		94 (%)		85 (%)		35 (%)		94 (%)		92 (%)		59 (%)		72 (%)		64 (%)		113 (%)		69 (%)		68 (%)		103 (%)		84 (%)		113 (%)		73 (%)		78 (%)		59 (%)		59 (%)		73 (%)	

Analyte	Reporting Limit (soil)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah	DWH-F1	DWH-F2
AROMATC & TOTAL PURGEABLE PETROLEUM HYDROCARBONS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)															
Benzene	0.0025	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	ND
Toluene	0.0025	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	ND
Ethylbenzene	0.0025	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	ND
Xylenes (Total)	0.0025	ND		ND		ND		ND		**0.26**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	ND
Methyl tert-Butyl Ether (MTBE)	0.125	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	ND
Surrogate 4-BFB (PID)		103 (%)		102 (%)		100 (%)		112 (%)		95 (%)		94 (%)		108 (%)		101 (%)		138 (%)		99 (%)		132 (%)		72 (%)		72 (%)		129 (%)		71 (%)		65 (%)		70 (%)		64 (%)		70 (%)		95 (%)		68 (%)		85 (%)	82 (%)

Analyte	Reporting Limit (soil)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)													
Oil & Grease	10		**192**		**93**		ND		**36**		**51,800**		ND		**75,600**		ND		**53,800**		ND		**109,000**		**153**		**129**		**118,000**		**30**		**930**		ND		ND		ND		ND		**39**

TPH: Total Petroleum Hydrocarbons

ND: None Detected at Reporting Limit

NC: A result could not be calculated due to matrix interference.

mg/kg: milligrams/kilogram = parts per million

µg/L: micrograms/liter = parts per billion

*Reporting Limit - 10 mg/kg

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

HOLLAND ISLAND

SOIL SAMPLE RESULTS

Pesticides, Organics, Inorganics

Analyte	Reporting Limit (soil) (mg/kg)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah	DWH-F1	DWH-F2
ORGANOPHOSPHORUS PESTICIDES																																													
Chlorpyrifos (Dursban)	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Coumaphos	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Demeton (O & S)	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Diazinon	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Dichlorvos	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Disulfoton (Di-Syston)	14	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Ethoprophos (Prophos)	14	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Fensulfothion	2	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Fenthion	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Azinphos methy (Guthion)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Merphos	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Parathion methyl	14	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Naled (Dibrom)	14	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Phorate (Thimet)	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Mevinphos (Phosdrin)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Ronnel (Fenchlorophos)	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Bolstar (Sulprofos)	2	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Stirophos (Tetrachlorvinphos)	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Tokuthion (Prothiofos)	0.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Trichloronate	2	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Surrogate-Tributylphosphate		44 (%)		NC		NC		NC		298 (%)		NC		NC		51 (%)		134 (%)		62 (%)		NC		58 (%)		62 (%)		188 (%)		80 (%)		56 (%)		65 (%)		68 (%)		54 (%)		66 (%)		56 (%)			
Surrogate-Triphenylphosphate		88 (%)		62 (%)		60 (%)		60 (%)		669 (%)		61 (%)		NC		57 (%)		NC		69 (%)		191 (%)		65 (%)		68 (%)		NC		95 (%)		70 (%)		70 (%)		71 (%)		64 (%)		67 (%)		60 (%)			

Analyte	Reporting Limit (soil) (mg/kg)	DWH-1a	DWH-1ah	DWH-1b	DWH-1bh	DWH-2a	DWH-2ah	DWH-2b	DWH-2bh	DWH-3a *	DWH-3ah	DWH-3b	DWH-3bh	DWH-4a	DWH-4ah	DWH-4b	DWH-4bh	DWH-5a	DWH-5ah	DWH-5b	DWH-5bh	DWH-6a	DWH-6ah	DWH-6b1	DWH-6bh1	DWH-6b2	DWH-6bh2	DWH-7a	DWH-7ah	DWH-7b	DWH-7bh	DWH-8a	DWH-8ah	DWH-8b1	DWH-8bh1	DWH-8b2	DWH-8bh2	DWH-9a	DWH-9ah	DWH-10a	DWH-10ah	DWH-11a	DWH-11ah	DWH-F1	DWH-F2
SEMIVOLATILE ORGANIC COMPOUNDS																																													
Acenaphtene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Acenaphthylene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Anthracene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Benzo(a)anthracene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Benzo(b)fluoranthene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Benzo(k)fluoranthene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Benzo(ghi)perylene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Benzo(a)pyrene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Chrysene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Dibenzo(a,h)anthracene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Fluoranthene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Fluorene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Indeno(1,2,3-cd)pyrene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Napthalene	0.33	ND		ND		ND		ND		**12**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Phenanthrene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Pyrene	0.33	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			
Surrogate Nitrobenzene-d5		91 (%)		84 (%)		86 (%)		94 (%)		69 (%)		88 (%)		34 (%)		89 (%)		13 (%)		79 (%)		116 (%)		92 (%)		90 (%)		38 (%)		83 (%)		85 (%)		86 (%)		86 (%)		83 (%)		95 (%)		86 (%)			
Surrogate 2-Fuorobiphenyl		93 (%)		86 (%)		86 (%)		94 (%)		100 (%)		87 (%)		42 (%)		86 (%)		16 (%)		90 (%)		136 (%)		90 (%)		90 (%)		51 (%)		93 (%)		90 (%)		86 (%)		83 (%)		85 (%)		102 (%)		87 (%)			
Surrogate Terphenyl-d14		129 (%)		95 (%)		88 (%)		103 (%)		101 (%)		81 (%)		54 (%)		129 (%)		26 (%)		121 (%)		205 (%)		83 (%)		78 (%)		78 (%)		136 (%)		127 (%)		95 (%)		100 (%)		102 (%)		98 (%)		103 (%)			
Surrogate 2-Fuorophenol		73 (%)		68 (%)		72 (%)		76 (%)		79 (%)		70 (%)		29 (%)		73 (%)		11 (%)		70 (%)		82 (%)		72 (%)		69 (%)		33 (%)		54 (%)		62 (%)		46 (%)		63 (%)		67 (%)		78 (%)		59 (%)			
Surrogate Phenol-d6		86 (%)		79 (%)		83 (%)		86 (%)		78 (%)		77 (%)		34 (%)		84 (%)		13 (%)		79 (%)		98 (%)		84 (%)		84 (%)		38 (%)		73 (%)		78 (%)		76 (%)		76 (%)		77 (%)		91 (%)		75 (%)			
Surrogate 2,4,6-Tribromophenol		90 (%)		90 (%)		91 (%)		101 (%)		NC		97 (%)		21 (%)		96 (%)		12 (%)		82 (%)		80 (%)		94 (%)		96 (%)		28 (%)		75 (%)		88 (%)		77 (%)		72 (%)		81 (%)		99 (%)		86 (%)			

TPH: Total Petroleum Hydrocarbons

ND: None Detected at Reporting Limit

NC: A result could not be calculated due to matrix interference.

mg/kg: milligrams/kilogram = parts per million

µg/L: micrograms/liter = parts per billion

* Sample diluted due to a high concentration of non-target analyte(s), resulting in and increased reporting limit of 6.6 mg/kg.

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

METALS

Analyte	Reporting Limit (Soil) (mg/kg)	Reporting Limit (Water) (mg/L)	TTLC* for Metals (mg/kg)	DWW-12a (mg/kg)	DWW-12ah (mg/kg)	DWW-12b (mg/kg)	DWW-12bh (mg/kg)	DWW-13a (mg/kg)	DWW-13ah (mg/kg)	DWW-13b (mg/kg)	DWW-13bh (mg/kg)	DWW-14a (mg/kg)	DWW-14ah (mg/kg)	DWW-14b1 (mg/L)	DWW-14b2 (mg/L)	DWW-14bh1 (mg/L)	DWW-14bh2 (mg/kg)	DWW-15a (mg/kg)	DWW-15ah (mg/kg)	DWW-15b (mg/kg)	DWW-15bh (mg/kg)	DWW-16a (mg/kg)	DWW-16ah (mg/kg)	DWW-16b (mg/kg)	DWW-16bh (mg/kg)	DWW-17EB (mg/kg)	DWW-18a (mg/kg)	DWW-18ah (mg/L)	DWW-19a (mg/kg)	DWW-19ah (mg/kg)	DWW-20a1 (mg/kg)	DWW-20ah1 (mg/kg)	DWW-20a2 (mg/kg)	DWW-20ah2 (mg/kg)	DWW-20b (mg/kg)	DWW-20bh (mg/kg)	DWW-21a (mg/kg)	DWW-21ah (mg/kg)	DWW-EB
Antimony	2	0.006	500			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND
Arsenic	1	0.002	500	**3**		**1**		**4**		**5**		**3**		**3**	**2**			**4**		**37**		**7**		**2**			**5**		**7**		**5**		**4**		**13**		**18**		ND
Barium	1	0.1	10,000	**65**		**14**		**31**		**38**		**31**		**16**	**14**			**36**		**21**		**48**		**33**			**90**		**97**		**1500**		**1500**		**250**		**260**		ND
Beryllium	0.2	0.001	75			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND
Cadmium	0.2	0.001	1000	**0.3**		ND		**1.3**		ND		ND		ND	ND			ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND
Hexavalent Chromium	0.5	0.01			ND		ND		ND		ND		ND			ND	ND		ND		ND		ND		ND	ND		ND		ND		ND		ND		ND		ND	ND
Total Chromium	1	0.01	2,500	**7**		**4**		**14**		**6**		**6**		**5**	**5**			**6**		**6**		**6**		**6**			**41**		**30**		**21**		**17**		**49**		**48**		ND
Cobalt	0.4	0.01	8,000	**1.6**		**1.7**		**1.8**		**2.4**		**1.8**		**1.6**	**1.6**			**1.6**		**2**		**2.1**		**2.3**			**13**		**8.9**		**5.1**		**5.5**		**8.1**		**8.2**		ND
Copper	1	0.01	2,500	**11**		**1**		**110**		**2**		**7**		**1**	ND			**3**		**1**		**3**		**2**			**24**		**24**		**11**		**12**		**30**		**45**		ND
Lead	1	0.005	1,000	**75**		**2**		**5**		**2**		**11**		**2**	**1**			**6**		**2**		**3**		**2**			**6**		**8**		**9**		**9**		**7**		**11**		ND
Mercury	0.02	0.001	20			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			**0.09**		**0.09**		**0.15**		**0.21**		**0.04**		**0.06**		ND
Molybdenum	1	0.01	3,500			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			ND		**1**		ND		ND		**1**		**3**		ND
Nickel	1	0.01	2,000	**6**		**6**		**7**		**7**		**6**		**5**	**5**			**6**		**6**		**6**		**7**			**59**		**32**		**21**		**22**		**45**		**47**		ND
Selenium	2	0.005	100			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND
Silver	0.6	0.01	500			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND
Thallium	2	0.001	700			ND		ND		ND		ND		ND	ND			ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND
Vanadinium	0.4	0.01	2,400	**9.4**		**8.5**		**24**		**12**		**8.7**		**7.2**	**7.3**			**9.2**		**8.2**		**11**		**9.7**			**42**		**43**		**21**		**23**		**91**		**100**		ND
Zinc	4	0.01	5,000	**440**		**8**		**140**		**9**		**390**		**12**	**8**			**390**		**10**		**17**		**9**			**54**		**47**		**52**		**58**		**49**		**51**		ND

ND: None Detected at Reporting Limit

mg/kg: millligrams/kilogram = parts per million

µg/L: micrograms/liter = parts per billion

*Total Threshold Limit Concentration given in Title 22 California Code of Regulations, secion 66261.24

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

pH, Chlorinated Pesticides, PCBs, PAH, Oil & Grease

Analyte	Reporting Limit (soil)	DWW-12a	DWW-12b	DWW-13a	DWW-13b	DWW-14a	DWW-14b1	DWW-14b2	DWW-15a	DWW-15b	DWW-16a	DWW-16b	DWW-18a	DWW-19a	DWW-20a1	DWW-20a2	DWW-20b	DWW-21a
	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	(units)	
pH	-	6.6	8.2	6	8.1	5.9	7.7	7.9	7.3	7.8	7.4	8.2	5.7	5.4	6.6	6.6	5.4	4.5

Analyte	Reporting Limit (soil)	DWW-12a	DWW-12ah	DWW-12b	DWW-12bh	DWW-13a	DWW-13ah	DWW-13b	DWW-13bh	DWW-14a	DWW-14ah	DWW-14b1	DWW-14bh1	DWW-14b2	DWW-14bh2	DWW-15a	DWW-15ah	DWW-15b	DWW-15bh	DWW-16a	DWW-16ah	DWW-16b	DWW-16bh	DWW-17EB	DWW-18a	DWW-18ah	DWW-19a	DWW-19ah	DWW-20a1	DWW-20ah1	DWW-20a2	DWW-20ah2	DWW-20b	DWW-20bh	DWW-21a	DWW-21ah
CHLORINATED PESTICIDES	(mg/kg)																																			
Aldrin	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
alpha-BHC	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
beta-BHC	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
gamma-BHC (Lindane)	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
delta-BHC	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Chlordane	0.6	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
p,p'-DDD	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
p,p'-DDE	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
p,p'-DDT	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Dieldrin	0.3	ND		ND		**0.013**		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		**0.058**	
Endosulfan	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Endosulfan II	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Endosulfan Sulfate	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Endrin	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Endrin Aldehyde	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Endrin Ketone	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Heptachlor	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Heptachlor Epoxide	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Methoxychlor	0.3	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Toxaphene	0.0	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Surrogate TCMX		NC		**69 (%)**		**66 (%)**		**78 (%)**		NC		**87 (%)**		**100 (%)**		NC		**90 (%)**		**109 (%)**		**83 (%)**			**89 (%)**		**104 (%)**		**187 (%)**		**69 (%)**		**71 (%)**		**87 (%)**	
Surrogate Decachlorobiphenyl		NC		**43 (%)**		**35 (%)**		**50 (%)**		**228 (%)**		**35 (%)**		**44 (%)**		**267 (%)**		**35 (%)**		**34 (%)**		**45 (%)**			**50 (%)**		**50 (%)**		**73 (%)**		**11 (%)**		**36 (%)**		**69 (%)**	

Analyte	Reporting Limit (soil)	DWW-12a		DWW-12b	DWW-12bh	DWW-13a	DWW-13ah	DWW-13b	DWW-13bh	DWW-14a	DWW-14ah	DWW-14b1	DWW-14bh1	DWW-14b2	DWW-14bh2	DWW-15a	DWW-15ah	DWW-15b	DWW-15bh	DWW-16a	DWW-16ah	DWW-16b	DWW-16bh	DWW-17EB	DWW-18a	DWW-18ah	DWW-19a	DWW-19ah	DWW-20a1	DWW-20ah1	DWW-20a2	DWW-20ah2	DWW-20b	DWW-20bh	DWW-21a	DWW-21ah
	(mg/kg)	(mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)						
POLYCHLORINATED BEPHENYLS																																				
PCB 1016	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
PCB 1221	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
PCB 1232	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
PCB 1242	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
PCB 1248	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
PCB 1254	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
PCB 1260	0.04	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND	
Surrogate TCMX		**57 (%)**		**50 (%)**		**45 (%)**		**52 (%)**		**80 (%)**		**52 (%)**		**59 (%)**		**80 (%)**		**57 (%)**		**60 (%)**		**76 (%)**			**92 (%)**		**86 (%)**		**72 (%)**		**77 (%)**		**73 (%)**		**87 (%)**	
Surrogate Decachlorobiphenyl		**110 (%)**		**51 (%)**		**45 (%)**		**60 (%)**		**65 (%)**		**54 (%)**		**65 (%)**		**98 (%)**		**63 (%)**		**88 (%)**		**107 (%)**			**105 (%)**		**98 (%)**		**75 (%)**		**65 (%)**		**85 (%)**		**101 (%)**	

Analyte	Reporting Limit (soil)	DWW-12a	DWW-12ah	DWW-12b	DWW-12bh	DWW-13a	DWW-13ah	DWW-13b	DWW-13bh	DWW-14a	DWW-14ah	DWW-14b1	DWW-14bh1	DWW-14b2	DWW-14bh2	DWW-15a	DWW-15ah	DWW-15b	DWW-15bh	DWW-16a	DWW-16ah	DWW-16b	DWW-16bh	DWW-17EB	DWW-18a	DWW-18ah	DWW-19a	DWW-19ah	DWW-20a1	DWW-20ah1	DWW-20a2	DWW-20ah2	DWW-20b	DWW-20bh	DWW-21a	DWW-21ah	DWW-FB1	DWW-FB2
AROMATC & TOTAL PURGEABLE PETROLEUM HYDROCARBONS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)								
Benzene	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND	ND
Toluene	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND	ND
Ethylbenzene	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND	ND
Xylenes (Total)	0.013	ND		ND		ND		ND		ND		ND		ND		ND		ND		**0.17**		**0.013**			ND		ND		ND		ND		ND		ND		ND	ND
Methyl tert-Butyl Ether (MTBE)	0.63	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND	ND
Surrogate 4-BFB (FID)		**353 (%)**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND		ND	ND
Surrogate 4-BFB (PID)		**122 (%)**		**98 (%)**		**121 (%)**		**97 (%)**		**132 (%)**		**99 (%)**		**105 (%)**		**133 (%)**		**104 (%)**		**125 (%)**		**93 (%)**			**96 (%)**		**63 (%)**		**61 (%)**		**59 (%)**		**100 (%)**		**96 (%)**		**75 (%)**	**75 (%)**

Analyte	Reporting Limit (soil)	DWW-12a	DWW-12ah	DWW-12b	DWW-12bh	DWW-13a	DWW-13ah	DWW-13b	DWW-13bh	DWW-14a	DWW-14ah	DWW-14b2	DWW-14b1	DWW-14bh1	DWW-14bh2	DWW-15a	DWW-15ah	DWW-15b	DWW-15bh	DWW-16a	DWW-16ah	DWW-16b	DWW-16bh	DWW-17EB	DWW-18a	DWW-18ah	DWW-19a	DWW-19ah	DWW-20a1	DWW-20ah1	DWW-20a2	DWW-20ah2	DWW-20b	DWW-20bh	DWW-21a	DWW-21ah	Lab Blank
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)							
Oil & Grease	10		**79,200**		ND		**8,100**		ND		**125,000**		**1,230**		**1,350**		**128,000**		**423**		**30,700**		**1,740**			ND		**36**		**67,200**		**63,000**		**870**		ND	ND

TPH: Total Petroleum Hydrocarbons
ND: None Detected at Reporting Limit
NC: A result could not be calculated due to matrix interference.
mg/kg: milligrams/kilogram = parts per million
µg/L: micrograms/liter = parts per billion
*Reporting Limit - 10 mg/kg

DELTA WETLANDS / IN-DELTA STORAGE, PHASE II ESA

SOIL SAMPLE RESULTS

Organophosphorus Pesticides & Semivolitile Organic Compounds

Analyte	Reporting Limit (soil)	DWW-12a	DWW-12ah	DWW-12b	DWW-12bh	DWW-13a	DWW-13ah	DWW-13b	DWW-13bh	DWW-14a	DWW-14ah	DWW-14b1	DWW-14bh1	DWW-14b2	DWW-14bh2	DWW-15a	DWW-15ah	DWW-15b	DWW-15bh	DWW-16a	DWW-16ah	DWW-16b	DWW-16bh	DWW-17EB	DWW-18a	DWW-18ah	DWW-19a	DWW-19ah	DWW-20a1	DWW-20ah1	DWW-20a2	DWW-20ah2	DWW-20b	DWW-20bh	DWW-21a	DWW-21ah	DWW-FB1	DWW-FB2
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)								
ORGANOPHOSPHORUS PESTICIDES																																						
Chlorpyrifos (Dursban)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Coumaphos	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Demeton (O & S)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Diazinon	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Dichlorvos	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Disulfoton (Di-Syston)	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Ethoprophos (Prophos)	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Fensulfothion	10	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Fenthion	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Azinphos methy (Guthion)	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Merphos	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Parathion methyl	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Naled (Dibrom)	70	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Phorate (Thimet)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Mevinphos (Phosdrin)	20	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Ronnel (Fenchlorophos)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Bolstar (Sulprofos)	10	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Stirophos (Tetrachlorvinphos)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Tokuthion (Prothiofos)	4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Trichloronate	10	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Surrogate-Tributylphosphate		**75 (%)**		**54 (%)**		**83 (%)**		**NC**		**NC**		**NC**		**106 (%)**		**NC**		**NC**		**NC**		**NC**			**77 (%)**		**NC**		**226 (%)**		**140 (%)**		**83 (%)**		**NC**			
Surrogate-Triphenylphosphate		**96 (%)**		**49 (%)**		**127 (%)**		**65 (%)**		**553 (%)**		**501 (%)**		**132 (%)**		**519 (%)**		**231 (%)**		**254 (%)**		**236 (%)**			**109 (%)**		**175 (%)**		**184 (%)**		**181 (%)**		**123 (%)**		**147 (%)**			

Analyte	Reporting Limit (soil)	DWW-12a	DWW-12ah	DWW-12b	DWW-12bh	DWW-13a	DWW-13ah	DWW-13b	DWW-13bh	DWW-14a	DWW-14ah	DWW-14b1	DWW-14bh1	DWW-14b2	DWW-14bh2	DWW-15a	DWW-15ah	DWW-15b	DWW-15bh	DWW-16a	DWW-16ah	DWW-16b	DWW-16bh	DWW-17EB	DWW-18a	DWW-18ah	DWW-19a	DWW-19ah	DWW-20a1	DWW-20ah1	DWW-20a2	DWW-20ah2	DWW-20b	DWW-20bh	DWW-21a	DWW-21ah	DWW-FB1	DWW-FB2
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)								
SEMIVOLATILE ORGANIC COMPOUNDS																																						
Acenaphtene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Acenaphthylene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Anthracene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Benzo(a)anthracene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Benzo(b)fluoranthene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Benzo(k)fluoranthene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Benzo(ghi)perylene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Benzo(a)pyrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Chrysene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Dibenzo(a,h)anthracene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Fluoranthene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Fluorene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Indeno(1,2,3-cd)pyrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Napthalene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**0.45**			ND		ND		ND		ND		ND		ND			
Phenanthrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Pyrene	50	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND			ND		ND		ND		ND		ND		ND			
Surrogate Nitrobenzene-d5		**86 (%)**		**89 (%)**		**97 (%)**		**96 (%)**		**104 (%)**		**98 (%)**		**86 (%)**		**86 (%)**		**90 (%)**		**112 (%)**		**116 (%)**			**86 (%)**		**95 (%)**		**83 (%)**		**76 (%)**		**80 (%)**		**90 (%)**			
Surrogate 2-Fuorobiphenyl		**109 (%)**		**90 (%)**		**105 (%)**		**86 (%)**		**124 (%)**		**113 (%)**		**97 (%)**		**87 (%)**		**90 (%)**		**124 (%)**		**115 (%)**			**86 (%)**		**99 (%)**		**112 (%)**		**108 (%)**		**71 (%)**		**89 (%)**			
Surrogate Terphenyl-d14		**115 (%)**		**100 (%)**		**160 (%)**		**99 (%)**		**17 (%)**		**170 (%)**		**141 (%)**		**16 (%)**		**107 (%)**		**80 (%)**		**83 (%)**			**70 (%)**		**90 (%)**		**161 (%)**		**164 (%)**		**68 (%)**		**89 (%)**			
Surrogate 2-Fuorophenol		**71 (%)**		**75 (%)**		**80 (%)**		**73 (%)**		**77 (%)**		**79 (%)**		**72 (%)**		**67 (%)**		**71 (%)**		**92 (%)**		**84 (%)**			**70 (%)**		**76 (%)**		**83 (%)**		**78 (%)**		**65 (%)**		**73 (%)**			
Surrogate Phenol-d6		**86 (%)**		**87 (%)**		**94 (%)**		**86 (%)**		**98 (%)**		**94 (%)**		**80 (%)**		**77 (%)**		**82 (%)**		**107 (%)**		**90 (%)**			**84 (%)**		**90 (%)**		**97 (%)**		**93 (%)**		**75 (%)**		**84 (%)**			
Surrogate 2,4,6-Tribromophenol		**54 (%)**		**87 (%)**		**69 (%)**		**92 (%)**		**92 (%)**		**86 (%)**		**91 (%)**		**67 (%)**		**75 (%)**		**76 (%)**		**112 (%)**			**90 (%)**		**103 (%)**		**82 (%)**		**90 (%)**		**77 (%)**		**85 (%)**			

TPH: Total Petroleum Hydrocarbons

ND: None Detected at Reporting Limit

NC: A result could not be calculated due to matrix interference.

mg/kg: millligrams/kilogram = parts per million

μg/L: micrograms/liter = parts per billion

+Reporting Limit - 10 mg/kg

APPENDIX C

Soil sample analytical results consist of approximately 300 pages. A copy of the results will be provided upon request.

APPENDIX D

PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

PHOTO 5

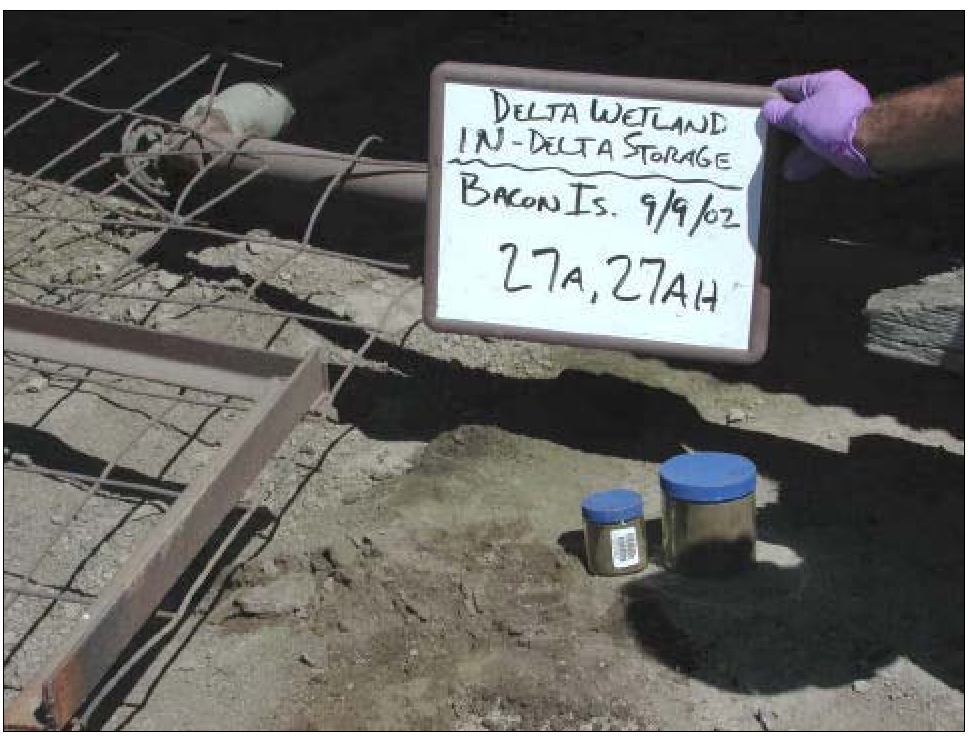


PHOTO 6

PHOTO 7

PHOTO 8

PHOTO 9

PHOTO 10


DELTA WETLAND
IN-DELTA STORAGE
BOULDIN IS. 9/10/02
30A1, 30AH1,
30A2, 30AH2,
30C, 30CH
30B

PHOTO 11

BOULDIN ISLAND

PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

PHOTO 5

PHOTO 6

PHOTO 7

PHOTO 8

PHOTO 9

PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

PHOTO 5

PHOTO 6

PHOTO 7

PHOTO 8

PHOTO 9

PHOTO 10

PHOTO 11

PHOTO 12

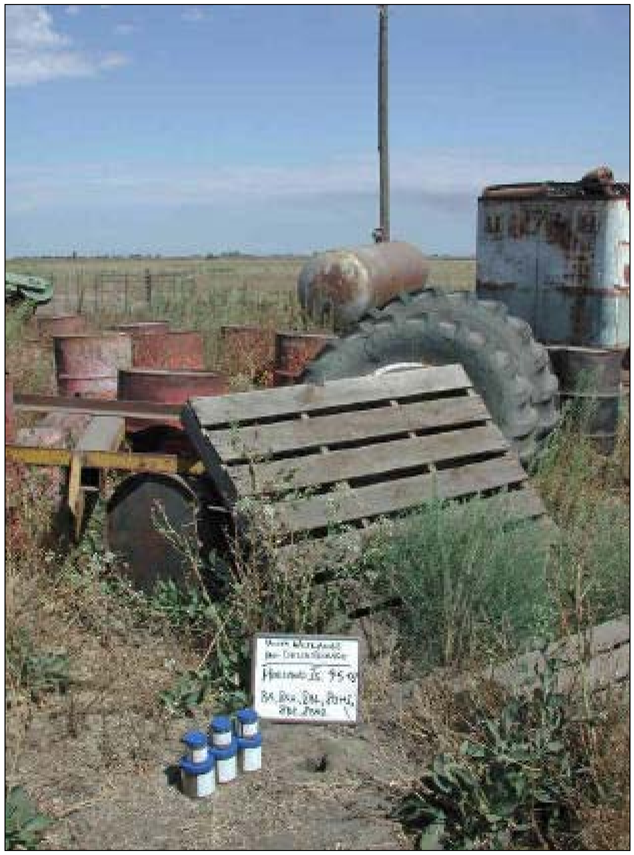


PHOTO 13

PHOTO 14

PHOTO 15

PHOTO 16


DELTA WETLANDS
IN-DELTA STORAGE
HOLLAND IS. 9-5-02
F1, F2
(FIELD BLANKS)
GLASS
THIS SIDE UP
WITH CARE

PHOTO 17

PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

PHOTO 5

PHOTO 6

WEBB TRACT

PHOTO 7

PHOTO 8

PHOTO 9

PHOTO 10

PHOTO 11

PHOTO 12

PHOTO 13

PHOTO 14

PHOTO 15

PHOTO 16

APPENDIX E

NELAP Certification 01103CA

Caltest

ANALYTICAL LABORATORY

ENVIRONMENTAL ANALYSES

ELAP Certification 1664

LAB ORDER No.: C090415

SUPPLEMENTAL QUALITY CONTROL (QC) DATA REPORT

Report Date: 08 OCT 2002
Received Date: 12 SEP 2002

Client: Bill Nickels
Dept.Water Res.-Bryte Chem Lab
1450 Riverbank Rd
West Sacramento, CA 95605

Project: DELTA WETLANDS-BOULDIN IS.,BACON IS.

QC Batch ID	Method	Matrix
A021099ICP	6010B	SOLID
A021104ICP	200.7	AQUEOUS
A021121MER	7471A	SOLID
I020012PH	9045C	SOLID
S020076BNA	8270	SOLID
T020261OCP	8082	SOLID
T020261OCP	8081A	SOLID
T020267OCP	8082	SOLID
T020267OCP	8081A	SOLID
T020269OPP	8141A	SOLID
V020072G9A	8015/8020A	SOLID
V020073G9A	8015/8020A	SOLID
V020074G9A	8015/8020A	AQUEOUS
V020107MSB	8260	SOLID
V020108MSB	8260	SOLID

William Svoboda
William Svoboda
Project Manager

CAHorn
Christine Horn
Laboratory Director

Results are specific to the sample as submitted and only to the parameters reported.
All analyses performed by EPA Methods or Standard Methods (SM) 18th Ed. except where noted.
Results of 'ND' mean not detected at or above the listed Reporting Limit (R.L.).
Analyte Spike Amounts reported as 'NS' mean not spiked and will not have recoveries reported.
'RPD' means Relative Percent Difference and RPD Acceptance Criteria is stated as a maximum.
'NC' means not calculated for RPD or Spike Recoveries.

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LAB ORDER No.: C090415

METHOD BLANK ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	ANALYZED	NOTES
QC BATCH: A021099ICP					
Antimony	ND	2.	mg/kg	09.20.02	
Arsenic	ND	1.	mg/kg	09.23.02	
Barium	ND	1.	mg/kg	09.20.02	
Beryllium	ND	0.2	mg/kg	09.20.02	
Cadmium	ND	0.2	mg/kg	09.20.02	
Chromium	ND	1.	mg/kg	09.20.02	
Cobalt	ND	0.4	mg/kg	09.20.02	
Copper	ND	1.	mg/kg	09.23.02	
Lead	ND	1.	mg/kg	09.20.02	
Molybdenum	ND	1.	mg/kg	09.20.02	
Nickel	ND	1.	mg/kg	09.20.02	
Selenium	ND	2.	mg/kg	09.20.02	
Silver	ND	0.6	mg/kg	09.20.02	
Thallium	ND	2.	mg/kg	09.20.02	
Vanadium	ND	0.4	mg/kg	09.20.02	
Zinc	ND	4.	mg/kg	09.20.02	
QC BATCH: A021104ICP					
Chromium	ND	0.005	mg/L	09.18.02	
QC BATCH: A021121MER					
Mercury	ND	0.02	mg/kg	09.19.02	
QC BATCH: S020076BNA					
SEMIVOLATILE ORGANIC COMPOUNDS				09.20.02	
Acenaphthene	ND	0.33	mg/kg		
Acenaphthylene	ND	0.33	mg/kg		
Anthracene	ND	0.33	mg/kg		
Benzo(a)anthracene	ND	0.33	mg/kg		
Benzo(b)fluoranthene	ND	0.33	mg/kg		
Benzo(k)fluoranthene	ND	0.33	mg/kg		
Benzo(ghi)perylene	ND	0.33	mg/kg		
Benzo(a)pyrene	ND	0.33	mg/kg		
Chrysene	ND	0.33	mg/kg		
Dibenzo(a,h)anthracene	ND	0.33	mg/kg		
Fluoranthene	ND	0.33	mg/kg		
Fluorene	ND	0.33	mg/kg		
Indeno(1,2,3-cd)pyrene	ND	0.33	mg/kg		
Naphthalene	ND	0.33	mg/kg		
Phenanthrene	ND	0.33	mg/kg		

LAB ORDER No.: C090415

METHOD BLANK ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	ANALYZED	NOTES
QC BATCH: S020076BNA (continued)					
SEMIVOLATILE ORGANIC COMPOUNDS (continued)				09.20.02	
Pyrene	ND	0.33	mg/kg		
Surrogate Nitrobenzene-d5	80.		%		
Surrogate 2-Fluorobiphenyl	83.		%		
Surrogate Terphenyl-d14	66.		%		
Surrogate 2-Fluorophenol	65.		%		
Surrogate Phenol-d6	76.		%		
Surrogate 2,4,6-Tribromophenol	82.		%		
QC BATCH: T0202610CP					
CHLORINATED PESTICIDES				09.16.02	1
Aldrin	ND	0.003	mg/kg		
alpha-BHC	ND	0.003	mg/kg		
beta-BHC	ND	0.003	mg/kg		
gamma-BHC (Lindane)	ND	0.003	mg/kg		
delta-BHC	ND	0.003	mg/kg		
Chlordane	ND	0.006	mg/kg		
p,p'-DDD	ND	0.003	mg/kg		
p,p'-DDE	ND	0.003	mg/kg		
p,p'-DDT	ND	0.003	mg/kg		
Dieldrin	ND	0.003	mg/kg		
Endosulfan I	ND	0.003	mg/kg		
Endosulfan II	ND	0.003	mg/kg		
Endosulfan Sulfate	ND	0.003	mg/kg		
Endrin	ND	0.003	mg/kg		
Endrin Aldehyde	ND	0.003	mg/kg		
Endrin Ketone	ND	0.003	mg/kg		
Heptachlor	ND	0.003	mg/kg		
Heptachlor Epoxide	ND	0.003	mg/kg		
Methoxychlor	ND	0.003	mg/kg		
Toxaphene	ND	0.02	mg/kg		
Surrogate TCMX	89.		%		
Surrogate Decachlorobiphenyl	91.		%		
POLYCHLORINATED BIPHENYLS (PCBS)				09.18.02	
PCB 1016	ND	0.05	mg/kg		
PCB 1221	ND	0.02	mg/kg		
PCB 1232	ND	0.02	mg/kg		
PCB 1242	ND	0.02	mg/kg		
PCB 1248	ND	0.02	mg/kg		
PCB 1254	ND	0.02	mg/kg		

1) This sample was analyzed following Florisil column cleanup (EPA Method 3620B).

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LAB ORDER No.: C090415

METHOD BLANK ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	ANALYZED	NOTES
QC BATCH: T0202610CP (continued)					
POLYCHLORINATED BIPHENYLS (PCBS) (continued)				09.18.02	
PCB 1260	ND	0.05	mg/kg		
Surrogate TCMX	88.		%		
Surrogate Decachlorobiphenyl	98.		%		
QC BATCH: T0202670CP					
CHLORINATED PESTICIDES				09.21.02	1
Aldrin	ND	0.003	mg/kg		
alpha-BHC	ND	0.003	mg/kg		
beta-BHC	ND	0.003	mg/kg		
gamma-BHC (Lindane)	ND	0.003	mg/kg		
delta-BHC	ND	0.003	mg/kg		
Chlordane	ND	0.006	mg/kg		
p,p'-DDD	ND	0.003	mg/kg		
p,p'-DDE	ND	0.003	mg/kg		
p,p'-DDT	ND	0.003	mg/kg		
Dieldrin	ND	0.003	mg/kg		
Endosulfan I	ND	0.003	mg/kg		
Endosulfan II	ND	0.003	mg/kg		
Endosulfan Sulfate	ND	0.003	mg/kg		
Endrin	ND	0.003	mg/kg		
Endrin Aldehyde	ND	0.003	mg/kg		
Endrin Ketone	ND	0.003	mg/kg		
Heptachlor	ND	0.003	mg/kg		
Heptachlor Epoxide	ND	0.003	mg/kg		
Methoxychlor	ND	0.003	mg/kg		
Toxaphene	ND	0.02	mg/kg		
Surrogate TCMX	78.		%		
Surrogate Decachlorobiphenyl	86.		%		
POLYCHLORINATED BIPHENYLS (PCBS)				09.23.02	
PCB 1016	ND	0.02	mg/kg		
PCB 1221	ND	0.02	mg/kg		
PCB 1232	ND	0.02	mg/kg		
PCB 1242	ND	0.02	mg/kg		
PCB 1248	ND	0.02	mg/kg		
PCB 1254	ND	0.02	mg/kg		
PCB 1260	ND	0.02	mg/kg		
Surrogate TCMX	77.		%		
Surrogate Decachlorobiphenyl	82.		%		

1) This sample was analyzed following Florisil column cleanup (EPA Method 3620B).

LAB ORDER No.: C090415

METHOD BLANK ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	ANALYZED	NOTES
QC BATCH: T0202690PP					
ORGANOPHOSPHORUS PESTICIDES				09.30.02	
Chlorpyrifos (Dursban)	ND	0.30	mg/kg		
Coumaphos	ND	1.5	mg/kg		
Demeton - O and - S	ND	0.30	mg/kg		
Diazinon	ND	0.30	mg/kg		
Dichlorvos	ND	0.30	mg/kg		
Disulfoton (Di-Syston)	ND	5.3	mg/kg		
Ethoprophos (Prophos)	ND	5.3	mg/kg		
Fensulfothion	ND	0.1	mg/kg		
Fenthion	ND	0.04	mg/kg		
Azinphos methyl (Guthion)	ND	1.5	mg/kg		
Merphos	ND	1.5	mg/kg		
Parathion methyl	ND	5.3	mg/kg		
Naled (Dibrom)	ND	5.3	mg/kg		
Phorate (Thimet)	ND	0.04	mg/kg		
Mevinphos (Phosdrin)	ND	1.5	mg/kg		
Ronnel (Fenchlorophos)	ND	0.30	mg/kg		
Bolstar (Sulprofos)	ND	0.8	mg/kg		
Stirophos (Tetrachlorvinphos)	ND	0.04	mg/kg		
Tokuthion (Prothiofos)	ND	0.04	mg/kg		
Trichloronate	ND	0.1	mg/kg		
Surrogate-Tributylphosphate	124.		%		
Surrogate-Triphenylphosphate	64.		%		
QC BATCH: V020072G9A					
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS				09.13.02	
Benzene	ND	0.0025	mg/kg		
Toluene	ND	0.0025	mg/kg		
Ethylbenzene	ND	0.0025	mg/kg		
Xylenes (Total)	ND	0.0025	mg/kg		
Methyl tert-Butyl Ether (MTBE)	ND	0.125	mg/kg		
Surrogate 4-Bromofluorobenzene [PID]	69.		%		
QC BATCH: V020073G9A					
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS				09.16.02	
Benzene	ND	0.0025	mg/kg		
Toluene	ND	0.0025	mg/kg		
Ethylbenzene	ND	0.0025	mg/kg		
Xylenes (Total)	ND	0.0025	mg/kg		
Methyl tert-Butyl Ether (MTBE)	ND	0.125	mg/kg		

LAB ORDER No.: C090415

METHOD BLANK ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	ANALYZED	NOTES
QC BATCH: V020073G9A (continued)					
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS (continued)				09.16.02	
Surrogate 4-Bromofluorobenzene [PID]	70.		%		
QC BATCH: V020074G9A					
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS				09.17.02	
Total Petroleum Hydrocarbons - Gasoline	ND	50.	ug/L		
TPH-Purgeable, quantitated as gasoline	ND	50.	ug/L		
Benzene	ND	0.5	ug/L		
Toluene	ND	0.5	ug/L		
Ethylbenzene	ND	0.5	ug/L		
Xylenes (Total)	ND	0.5	ug/L		
Methyl tert-Butyl Ether (MTBE)	ND	5.	ug/L		
Surrogate 4-Bromofluorobenzene [FID]	80.		%		
Surrogate 4-Bromofluorobenzene [PID]	75.		%		
QC BATCH: V020107MSB					
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS				09.18.02	
Benzene	ND	0.0025	mg/kg		
Toluene	ND	0.0025	mg/kg		
Ethylbenzene	ND	0.0025	mg/kg		
Xylenes (Total)	ND	0.0025	mg/kg		
Methyl tert-Butyl Ether (MTBE)	ND	0.125	mg/kg		
Surrogate 4-BFB	109.		%		
QC BATCH: V020108MSB					
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS				09.19.02	
Benzene	ND	0.0025	mg/kg		
Toluene	ND	0.0025	mg/kg		
Ethylbenzene	ND	0.0025	mg/kg		
Xylenes (Total)	ND	0.0025	mg/kg		
Methyl tert-Butyl Ether (MTBE)	ND	0.125	mg/kg		
Surrogate 4-BFB	101.		%		

LAB ORDER No.: C090415

LABORATORY CONTROL SAMPLE ANALYTICAL RESULTS

ANALYTE	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: A021099ICP							
Antimony	19.6	18.4\	94\	75-125\35		09.20.02	
Arsenic	19.2	19.7\	103\	75-125\35		09.23.02	
Barium	98.0	92.1\	94\	75-125\35		09.20.02	
Beryllium	19.6	19.4\	99\	75-125\35		09.20.02	
Cadmium	9.80	9.96\	102\	75-125\35		09.20.02	
Chromium	19.6	19.8\	101\	75-125\35		09.20.02	
Cobalt	19.6	19.2\	98\	75-125\35		09.20.02	
Copper	19.2	17.1\	89\	75-125\35		09.23.02	
Lead	98.0	98.4\	100\	75-125\35		09.20.02	
Molybdenum	19.6	18.7\	95\	75-125\35		09.20.02	
Nickel	19.6	20.2\	103\	75-125\35		09.20.02	
Selenium	19.6	19.4\	99\	75-125\35		09.20.02	
Silver	19.6	19.1\	97\	75-125\35		09.20.02	
Thallium	98.0	93.9\	96\	75-125\35		09.20.02	
Vanadium	19.6	19.4\	99\	75-125\35		09.20.02	
Zinc	98.0	101.\	103\	75-125\35		09.20.02	
QC BATCH: A021104ICP							
Chromium	0.0400	0.0400\	100\	80-120\20		09.18.02	
QC BATCH: A021121MER							
Mercury	0.100	0.0974\	97\	75-125\35		09.19.02	
QC BATCH: S020076BNA							
SEMIVOLATILE ORGANIC COMPOUNDS						09.20.02	
Acenaphthene	3.33	2.58\	77\	35-135\40			
Pyrene	3.33	2.53\	76\	30-130\35			
Surrogate Nitrobenzene-d5	3.33	2.91\	87\	20-120\			
Surrogate 2-Fluorobiphenyl	3.33	2.69\	81\	30-130\			
Surrogate Terphenyl-d14	3.33	2.06\	62\	30-130\			
Surrogate 2-Fluorophenol	6.67	4.71\	71\	20-120\			
Surrogate Phenol-d6	6.67	5.61\	84\	20-120\			
Surrogate 2,4,6-Tribromophenol	6.67	5.68\	85\	30-140\			

LAB ORDER No.: C090415

LABORATORY CONTROL SAMPLE ANALYTICAL RESULTS

ANALYTE	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: T0202610CP							
CHLORINATED PESTICIDES						09.16.02	1
Aldrin	0.0133	0.0100\	75\	19-134\35			
gamma-BHC (Lindane)	0.0133	0.0107\	80\	29-123\19			
p,p'-DDT	0.0133	0.0115\	86\	23-156\23			
Dieldrin	0.0133	0.0107\	80\	36-133\17			
Endrin	0.0133	0.0114\	85\	32-143\18			
Heptachlor	0.0133	0.0117\	88\	16-155\20			
Surrogate TCMX	0.0133	0.0120\	90\	10-119\			
Surrogate Decachlorobiphenyl	0.0133	0.0078\	59\	47-149\			
POLYCHLORINATED BIPHENYLS (PCBS)						09.18.02	
PCB 1260	0.0667	0.0721\	108\	50-120\			
Surrogate TCMX	0.0133	0.0121\	91\	10-119\			
Surrogate Decachlorobiphenyl	0.0133	0.0140\	105\	47-149\			
QC BATCH: T0202670CP							
CHLORINATED PESTICIDES						09.21.02	1
Aldrin	0.0133	0.0097\	73\	19-134\35			
gamma-BHC (Lindane)	0.0133	0.0095\	71\	29-123\19			
p,p'-DDT	0.0133	0.0107\	80\	23-156\23			
Dieldrin	0.0133	0.0101\	75\	36-133\17			
Endrin	0.0133	0.0102\	77\	32-143\18			
Heptachlor	0.0133	0.0101\	75\	16-155\20			
Surrogate TCMX	0.0133	0.0112\	84\	10-119\			
Surrogate Decachlorobiphenyl	0.0133	0.0111\	83\	47-149\			
POLYCHLORINATED BIPHENYLS (PCBS)						09.23.02	
PCB 1260	0.0667	0.0573\	86\	50-120\			
Surrogate TCMX	0.0133	0.0112\	84\	10-119\			
Surrogate Decachlorobiphenyl	0.0133	0.0120\	90\	47-149\			
QC BATCH: T0202690PP							
ORGANOPHOSPHORUS PESTICIDES						09.30.02	
Diazinon	0.2	0.125\	62\	40-140\			
Disulfoton (Di-Syston)	0.2	0.124\	62\	20-130\			
Azinphos methyl (Guthion)	0.2	0.126\	63\	40-140\			
Parathion methyl	0.2	0.128\	64\	40-140\			
Surrogate-Tributylphosphate	0.333	0.188\	56\	20-120\			
Surrogate-Triphenylphosphate	0.333	0.194\	58\	46-180\			

1) This sample was analyzed following Florisil column cleanup (EPA Method 3620B).

LAB ORDER No.: C090415

LABORATORY CONTROL SAMPLE ANALYTICAL RESULTS

ANALYTE	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: V020072G9A							
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS						09.13.02	1
Benzene	0.0128	0.0146\	114\	50-130\			
Toluene	0.0772	0.0780\	101\	60-140\			
Ethylbenzene	0.0184	0.0183\	99\	50-150\			
Xylenes (Total)	0.0924	0.0898\	97\	60-140\			
Methyl tert-Butyl Ether (MTBE)	0.0208	J0.0225\	108\				
Surrogate 4-Bromofluorobenzene [PID]	0.020	0.0144\	72\	50-130\			
QC BATCH: V020073G9A							
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS						09.16.02	1
Benzene	0.0128	0.0154\	120\	50-130\			
Toluene	0.0772	0.0825\	107\	60-140\			
Ethylbenzene	0.0184	0.0194\	105\	50-150\			
Xylenes (Total)	0.0924	0.0955\	103\	60-140\			
Methyl tert-Butyl Ether (MTBE)	0.0208	J0.0227\	109\				
Surrogate 4-Bromofluorobenzene [PID]	0.020	0.020\	100\	50-130\			
QC BATCH: V020074G9A							
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS						09.17.02	
Total Petroleum Hydrocarbons - Gasoline	550.	519.\543.	94\99	50-130\	4.5		
Benzene	6.4	7.73\7.91	121\124	50-130\	2.3		
Toluene	38.6	40.9\42.1	106\109	50-130\	2.9		
Ethylbenzene	9.2	9.75\9.94	106\108	50-130\	1.9		
Xylenes (Total)	46.2	47.4\48.2	103\104	60-130\	1.7		
Methyl tert-Butyl Ether (MTBE)	10.4	9.92\9.71	95\93		2.1		
Surrogate 4-Bromofluorobenzene [FID]	10.0	8.83\8.91	88\89	50-130\			
Surrogate 4-Bromofluorobenzene [PID]	10.0	8.22\8.03	82\80	50-130\			

1) A "J" flagged result indicates an estimated concentration above the Method Detection Limit (MDL) and below the RL/ML (Reporting Limit/Minimum Level). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

LAB ORDER No.: C090415

LABORATORY CONTROL SAMPLE ANALYTICAL RESULTS

ANALYTE	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: V020107MSB							
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS						09.18.02	
Benzene	0.0400	0.0354\0.0323	88\81	50-130\	9.2		
Toluene	0.0400	0.0341\0.0310	85\78	60-140\	9.5		
Ethylbenzene	0.0400	0.0344\0.0312	86\78	50-150\	9.8		
Xylenes (Total)	0.120	0.104\0.0950	87\79	60-140\	9.0		
Methyl tert-Butyl Ether (MTBE)	0.0400	0.0326\0.0412	82\103		23.		
Surrogate 4-BFB	0.0600	0.0594\0.0565	99\94	50-150\			
QC BATCH: V020108MSB							
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS						09.19.02	
Benzene	0.0400	0.0348\0.0358	87\90	50-130\	2.8		
Toluene	0.0400	0.0352\0.0355	88\89	60-140\	0.9		
Ethylbenzene	0.0400	0.0354\0.0357	88\89	50-150\	0.8		
Xylenes (Total)	0.120	0.108\0.109	90\91	60-140\	0.9		
Methyl tert-Butyl Ether (MTBE)	0.0400	0.0306\0.0346	76\86		12.		
Surrogate 4-BFB	0.0600	0.0560\0.0578	93\96	50-150\			

LAB ORDER No.: C090415

DUPLICATE SAMPLES ANALYTICAL RESULTS

ANALYTE	R.L.	ORIGINAL RESULT	DUPLICATE RESULT	REL% DIFF	ACCEPT LIMIT	ANALYZED	NOTES
QC BATCH: I020012PH							
QC SAMPLE LAB NUMBER: C090415-1							
pH		5.86	5.88	0.3	35	09.18.02	

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LAB ORDER No.: C090415

MATRIX SPIKE ANALYTICAL RESULTS

ANALYTE	ORIGINAL RESULT	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: A021099ICP								
QC SAMPLE LAB NUMBER: C090415-19								
Antimony	ND	19.6	J1.61\J1.18	8\6	75-125\35	31.	09.20.02	1,2
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Arsenic	13.9	19.2	29.9\31.1	83\90	75-125\35	3.9	09.23.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Barium	170.	98.0	256.\259.	88\91	75-125\35	1.2	09.20.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Beryllium	ND	19.6	17.2\17.6	88\90	75-125\35	2.3	09.20.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Cadmium	ND	9.80	8.02\8.17	82\83	75-125\35	1.9	09.20.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Chromium	37.7	19.6	54.2\55.3	84\90	75-125\35	2.0	09.20.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Cobalt	13.0	19.6	30.1\30.9	87\91	75-125\35	2.6	09.20.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Copper	26.4	19.2	42.8\43.5	85\89	75-125\35	1.6	09.23.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Lead	10.0	98.0	97.1\98.8	89\91	75-125\35	1.7	09.20.02	
QC BATCH: A021099ICP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
Molybdenum	1.14	19.6	13.0\13.2	61\62	75-125\35	1.5	09.20.02	1

1) Low Matrix Spike recovery(ies) due to possible matrix interferences in the QC sample. QC batch accepted based on LCS and RPD results.
2) A "J" flagged result indicates an estimated concentration above the Method Detection Limit (MDL) and below the RL/ML (Reporting Limit/Minimum Level). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

MATRIX SPIKE ANALYTICAL RESULTS

ANALYTE	ORIGINAL RESULT	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: A021099ICP (continued)								
QC BATCH: A021099ICP (continued) QC SAMPLE LAB NUMBER: C090415-19								
Nickel	45.7	19.6	62.6\64.6	86\96	75-125\35	3.1	09.20.02	
QC BATCH: A021099ICP (continued) QC SAMPLE LAB NUMBER: C090415-19								
Selenium	ND	19.6	15.9\16.5	81\84	75-125\35	3.7	09.20.02	
QC BATCH: A021099ICP (continued) QC SAMPLE LAB NUMBER: C090415-19								
Silver	ND	19.6	17.4\18.1	89\92	75-125\35	3.9	09.20.02	
QC BATCH: A021099ICP (continued) QC SAMPLE LAB NUMBER: C090415-19								
Thallium	ND	98.0	84.6\86.8	86\89	75-125\35	2.6	09.20.02	
QC BATCH: A021099ICP (continued) QC SAMPLE LAB NUMBER: C090415-19								
Vanadium	55.9	19.6	71.2\72.6	78\85	75-125\35	1.9	09.20.02	
QC BATCH: A021099ICP (continued) QC SAMPLE LAB NUMBER: C090415-19								
Zinc	61.4	98.0	146.\149.	86\89	75-125\35	2.0	09.20.02	
QC BATCH: A021104ICP QC SAMPLE LAB NUMBER: C090347-2								
Chromium	0.00507	0.0400	0.0452\0.0451	100\100	80-120\20	0.2	09.18.02	
QC BATCH: A021121MER QC SAMPLE LAB NUMBER: C090415-1								
Mercury	0.0791	0.100	0.173\0.170	94\91	75-125\35	1.7	09.19.02	
QC BATCH: T020261OCP QC SAMPLE LAB NUMBER: C090415-1								
CHLORINATED PESTICIDES							09.19.02	1,2
Aldrin	ND	0.0133	0.0345\0.0208	259\156	10-181\39	50.		

1) This sample was analyzed following Florisil column cleanup (EPA Method 3620B).
2) Matrix spike recovery(ies) and RPD outside control limit. Sample result accepted based on LCS and Method Blank.

LAB ORDER No.: C090415

MATRIX SPIKE ANALYTICAL RESULTS

ANALYTE	ORIGINAL RESULT	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: T0202610CP (continued)								
QC SAMPLE LAB NUMBER: C090415-1								
CHLORINATED PESTICIDES (continued)							09.19.02	
gamma-BHC (Lindane)	ND	0.0133	0.0171\0.0150	129\113	15-165\54	13.		
p,p'-DDT	ND	0.0133	0.0456\0.0316	343\238	10-202\70	36.		
Dieldrin	ND	0.0133	0.0185\0.0178	139\134	33-169\36	3.9		
Endrin	ND	0.0133	0.0158\0.0166	119\125	10-195\29	4.9		
Heptachlor	ND	0.0133	0.0153\0.00835	115\63	10-209\32	59.		
Surrogate TCMX	NC	0.0133	0.0301\0.0278	226\209	19-140\			
Surrogate Decachlorobiphenyl	NC	0.0133	0.0153\0.0152	115\114	40-138\			
QC BATCH: T0202610CP (continued)								
QC SAMPLE LAB NUMBER: C090415-2								
POLYCHLORINATED BIPHENYLS (PCBS)							09.18.02	1-4
PCB 1260	ND	0.0667	0.0659\0.0419	99\63	30-155\35	45.		
Surrogate TCMX	58.%	0.0133	0.0138\0.0048	104\36	19-140\			
Surrogate Decachlorobiphenyl	89.%	0.0133	0.0132\0.0085	99\64	40-138\			
QC BATCH: T0202670CP								
QC SAMPLE LAB NUMBER: C090415-18								
CHLORINATED PESTICIDES							09.22.02	5
Aldrin	ND	0.04	0.0203\0.0182	51\46	10-181\39	11.		
gamma-BHC (Lindane)	ND	0.04	0.0417\0.0553	104\138	15-165\54	28.		
p,p'-DDT	ND	0.04	0.0308\0.0251	77\63	10-202\70	20.		
Dieldrin	ND	0.04	0.0217\0.0191	54\48	33-169\36	13.		
Endrin	ND	0.04	0.0265\0.0220	66\55	10-195\29	19.		
Heptachlor	ND	0.04	0.0165\0.0170	41\42	10-209\32	3.0		
Surrogate TCMX	101.%	0.04	0.0378\0.0464	94\116	19-140\			
Surrogate Decachlorobiphenyl	50.%	0.04	0.0117\0.0152	29\38	40-138\			

1) The sample was analyzed following sulfuric acid cleanup (EPA Method 3665).
2) The final volume of the sample extract was higher than the nominal amount, resulting in (a) higher reporting limit(s).
3) Sample diluted due to a high concentration of non-target analyte(s), resulting in increased reporting limits.
4) Matrix spike recovery(ies) and RPD outside control limit. Sample result accepted based on LCS and Method Blank.
5) This sample was analyzed following Florisil column cleanup (EPA Method 3620B).

MATRIX SPIKE ANALYTICAL RESULTS

ANALYTE	ORIGINAL RESULT	SPIKE AMOUNT	SPIKE\DUP RESULT	SPK\DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: T0202670CP (continued)								
QC BATCH: T0202670CP (continued)								
QC SAMPLE LAB NUMBER: C090415-19								
POLYCHLORINATED BIPHENYLS (PCBS)							09.23.02	1
PCB 1260	ND	0.0667	0.0723\0.0678	108\102	30-155\35	6.4		
Surrogate TCMX	70.%	0.0133	0.0112\0.0118	84\88	19-140\			
Surrogate Decachlorobiphenyl	44.%	0.0133	0.0123\0.0119	92\89	40-138\			
QC BATCH: V020072G9A								
QC SAMPLE LAB NUMBER: C090231-12								
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS							09.13.02	2
Benzene	ND	0.032	0.0333\0.0351	104\110	20-120\35	5.3		
Toluene	ND	0.193	0.174\0.185	90\96	60-140\25	6.1		
Ethylbenzene	ND	0.046	0.0406\0.0426	88\93	20-120\25	4.8		
Xylenes (Total)	ND	0.231	0.199\0.209	86\90	10-110\35	4.9		
Methyl tert-Butyl Ether (MTBE)	ND	J0.052	J0.0528\J0.0593	102\114		12.		
Surrogate 4-Bromofluorobenzene [PID]	72.%	0.050	0.0390\0.0389	78\78	60-140\			
QC BATCH: V020073G9A								
QC SAMPLE LAB NUMBER: C090231-37								
AROMATIC HYDROCARBONS AND TOTAL PURGEABLE PETROLEUM HYDROCARBONS							09.16.02	2
Benzene	ND	0.032	0.0225\0.0241	70\75	20-120\35	6.9		
Toluene	ND	0.193	0.0917\0.100	48\52	60-140\25	8.7		
Ethylbenzene	ND	0.046	0.0151\0.0167	33\36	20-120\25	10.		
Xylenes (Total)	ND	0.231	0.0714\0.0785	31\34	10-110\35	9.5		
Methyl tert-Butyl Ether (MTBE)	ND	J0.052	J0.0518\J0.0521	100\100		0.6		
Surrogate 4-Bromofluorobenzene [PID]	61.%	0.050	0.0349\0.0323	70\65	60-140\			

1) The sample was analyzed following sulfuric acid cleanup (EPA Method 3665).
2) A "J" flagged result indicates an estimated concentration above the Method Detection Limit (MDL) and below the RL/ML (Reporting Limit/Minimum Level). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

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Caltest ANALYTICAL LABORATORY

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SAMPLE CHAIN OF CUSTODY

PAGE 1 OF 5

LAB ORDER #:

PROJECT # / PROJECT NAME: Delta Wetlands - Holland Is.

P.O. #

CLIENT: Ca. Dept. Water Resources

REPORT TO: Bill Nichols

ADDRESS: ~~901 P St.~~ 1450 Riverbank Rd

CITY: West Sacramento

STATE: CA

ZIP: ~~94236~~ 95605

BILLING ADDRESS: Same

PHONE #: (916) 375-6008

FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): Don Guy / Jim Gleim

ANALYSES REQUESTED

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	Title 22 TTLC	Title 22 Cr VI	BTEX/MTBE	Oil/Grease	Organochlorine Pesticides	PCB	PAH	Organotin Compds	REMARKS
	9/5/02	10:47	Soil	16 oz glass	N/A	DWH-1A		Grab	✓	✓		✓	✓	✓	✓	✓	✓	
	9/5/02	10:47	Soil	8 oz. glass	N/A	DWH-1AH					✓							
	9/5/02	11:00	Soil	16 oz.	N/A	DWH-1B			✓	✓		✓	✓	✓	✓	✓	✓	
	9/5/02	11:00	Soil	8 oz.	N/A	DWH-1BH					✓							
	9/5/02	11:09	Soil	16 oz	N/A	DWH-2A			✓	✓		✓	✓	✓	✓	✓	✓	
	9/5/02	11:09	Soil	8 oz	NA	DWH-2AH					✓							
	9/5/02	11:11	Soil	16 oz	NA	DWH-2B			✓	✓		✓	✓	✓	✓	✓	✓	
	9/5/02	11:11	Soil	8 oz	N/A	DWH-2BH					✓							
	9/5/02	12:00	Soil	16 oz	N/A	DWH-3A			✓	✓		✓	✓	✓	✓	✓	✓	
	9/5/02	12:00	Soil	~~16 oz~~ 8 oz.	N/A	DWH-3AH		Grab			✓							

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9.6.2 / 1645	[signature]			

FOR LAB USE ONLY

Samples: WC___ MICRO___ BIO___ AA___ SV___ VOA___ | pH? Y/N | TEMP:___ | SEALED: Y/N | INTACT: Y/N

BD: BIO___ WC___ AA___

CC: AA___ SV___ VOA___

SIL: HP___ PT___ QT___ VOA___

W/HNO_3___ H_2SO_4___ NaOH___

PIL: HNO_3___ H_2SO_4___ NaOH___ HCL___

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R___ PR___ M___ F___

REV. 2/99

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SAMPLE CHAIN OF CUSTODY

PAGE 2 OF 5

LAB ORDER #:

PROJECT # / PROJECT NAME: Delta Wetlands - Holland Island

P.O. #

CLIENT: DWR

REPORT TO: Bill Nickels

ADDRESS: 1450 Riverbank Rd. CITY: West Sacramento STATE: CA ZIP: 95605

BILLING ADDRESS: Same

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): Don (?) / Jim (?)

ANALYSES REQUESTED

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	Title 22 Metals TTLC	Title 22	STLC/TTLC	Oil/Grease	Org. Chlor. Pesticide	PCB	PAH / Organo. Phos. Compounds	REMARKS
	9/5/02	1204	Soil	16 oz	None	DWH-3B		Grab	✓		✓	✓	✓	✓	✓	✓	
		1204		8 oz		DWH-3BH				✓							
		1214		16 oz		DWH-4A			✓		✓	✓	✓	✓	✓	✓	
		1215		8 oz		DWH-4AH				✓							
		1222		16 oz.		DWH-4B			✓		✓	✓	✓	✓	✓	✓	
		1232		8 oz		DWH-4BH				✓							
		1335		16 oz		DWH-5A			✓		✓	✓	✓	✓	✓	✓	
		1335		8 oz		DWH-5AH				✓							
		1345		16 oz		DWH-5B			✓		✓	✓	✓	✓	✓	✓	
	9/5/02	1346	Soil	8 oz	None	DWH-5BH		Grab		✓							

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9-6-2 1645	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH? Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R____ PR____ M____ F____

REV. 2/99

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SAMPLE CHAIN OF CUSTODY

PAGE 3 OF ____ LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - HOLLAND ISLAND P.O. #:

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 Riverbank Rd. CITY: W. Sacramento STATE: CA ZIP: 95608

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: 916 375-6019 SAMPLER (PRINT & SIGN NAME): Don Guy / Jim Gleim

ANALYSES REQUESTED: [illegible] / Title 22 Metals TTLC / Cr. VI Title 22 / BTEX/MTBE / Oil/Grease / Org. Chlorine Pesticides / PCB / PAH / [illegible] Comp.

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH DUE DATE: ____

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	[illegible]	Title 22 Metals TTLC	Cr. VI Title 22	BTEX/MTBE	Oil/Grease	Org. Chlorine Pesticides	PCB	PAH	REMARKS
	9/5/02	1340	Soil	16oz	None	DWH-6A		Grab	✓		✓	✓	✓	✓	✓	✓	
		1341		8oz		DWH-6AH		Grab		✓							
		1352		16oz		DWH-6B1		Comp.	✓		✓	✓	✓	✓	✓	✓	
		1352		8oz		DWH-6BH1		Comp.		✓							
		1352		16oz		DWH-6B2		Comp.	✓		✓	✓	✓	✓	✓	✓	
		1352		8oz		DWH-6BH2		Comp.		✓							
		1410		16oz		DWH-7A		Grab	✓		✓	✓	✓	✓	✓	✓	
		1410		8oz		DWH-7AH				✓							
		1412		16oz		DWH-7B			✓		✓	✓	✓	✓	✓	✓	
	9/5/02	1412	Soil	8oz	None	DWH-7BH		Grab		✓							

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9-6-2 1645	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH? Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R ____ PR ____ M ____ F ____

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SAMPLE CHAIN OF CUSTODY

PAGE 4 OF 5

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLAND - HOLLAND ISLAND

P.O. #

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95608

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008

FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): DON GUY / JIM GLEIM

ANALYSES REQUESTED

TURN-AROUND TIME
☐ STANDARD
☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	Title 22 Metals	Cr. VI	Title 22	BTEX/MTBE	Oil/Grease	Organochlorine Pesticides	PCBs	PAH	REMARKS
	9/5/02	1418	SOIL	16oz	NONE	DWH-8A	GRAB		✓	✓		✓	✓	✓	✓	✓	✓	
		1418		8oz.		DWH-8AH	GRAB				✓							
		1425		16oz.		DWH-8B1	COMP.		✓	✓		✓	✓	✓	✓	✓	✓	
		1425		16oz		DWH-8B2			✓	✓		✓	✓	✓	✓	✓	✓	
		1425		8oz		DWH-8BH1					✓							
		1425		8oz		DWH-8BH2	COMP.				✓							
		1515		16oz		DWH-9A	GRAB		✓	✓		✓	✓	✓	✓	✓	✓	
		15:15		8oz		DWH-9AH					✓							
		15:35		16oz		DWH-10A			✓	✓		✓	✓	✓	✓	✓	✓	
	9/5/02	15:35	SOIL	8oz	NONE	DWH-10AH	GRAB				✓							

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9-6-02 1641	[signature]			

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH? Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

FOR LAB USE ONLY

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL VOA; OTC = Other Type Container

R____ PR____ M____ F____

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SAMPLE CHAIN OF CUSTODY

PAGE 5 OF 5 LAB ORDER #:

PROJECT # / PROJECT NAME: Delta Wetlands - Holland Island   P.O. #:

CLIENT: DWR   REPORT TO: Bill Nickels

ADDRESS: 1450 Riverbank Rd.   CITY: West Sacramento   STATE: CA   ZIP: 95605

BILLING ADDRESS: Same

PHONE #: (916) 375-6008   FAX PHONE: (916) 375-6019   SAMPLER (PRINT & SIGN NAME): Don Guy / Jim Gleim

ANALYSES REQUESTED

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	CA Title 22 Metals TTLC	Cr VI Title 22	BTEX/MTBE	Oil/Grease	Organophosphate Pesticide	PCB	PAH	Organochlorine Pesticide	REMARKS
	9/5/02	1552	Soil	16oz.	None	DWH - 11A		Grab	✓✓		✓	✓	✓	✓	✓	✓	
	9/5/02	1542	Soil	8oz	None	DWH - 11AH				✓							
	9/6/02	1450	Water	40oz. VOA	HCl	DWH - F1					✓		~~✓~~	~~✓~~	~~✓~~	~~✓~~	
	9/6/02	1450	Water ~~Soil~~	40 oz VOA	HCl	DWH - F2					✓		~~✓~~	~~✓~~	~~✓~~	~~✓~~	
	9/5/02	11:15	Water	1 Pint	HCl	DWH - EB		Grab	✓	✓							

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH   DUE DATE:

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9/6/02 1645	[signature]			

FOR LAB USE ONLY

Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: ___ SEALED: Y/N INTACT: Y/N

BD: BIO ___ WC ___ AA ___

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO_3 ___ H_2SO_4 ___ NaOH ___

PIL: HNO_3 ___ H_2SO_4 ___ NaOH ___ HCL ___

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R ___ PR ___ M ___ F ___

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SAMPLE CHAIN OF CUSTODY

PAGE 1 OF 4

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - WEBB TRACT

P.O. #

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): DON GUY / JIM GLEIM

ANALYSES REQUESTED

TURN-AROUND TIME ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	TITLE 22	(T.III) TITLE 22 Metals	BTEX / MTBE	OIL & GREASE	Chlorinated Pesticides	PCB	PAH	Organophosphorus Pesticides	REMARKS
	9/6/02	1050	SOIL	16oz.	NONE	DWW-12A			✓	✓		✓	✓	✓	✓	✓	✓	
	↓	1050	↓	8oz	↓	DWW-12AH					✓							
		1100		16oz		DWW-12B			✓	✓		✓	✓	✓	✓	✓	✓	
		1100		8oz		DWW-12BH					✓							
		1114		16oz		DWW-13A			✓	✓		✓	✓	✓	✓	✓	✓	
		1114		8oz		DWW-13AH			*	*	✓							
		11:16		16oz		DWW-13B			✓	✓		✓	✓	✓	✓	✓	✓	
		11:16		8oz		DWW-13BH					✓							
	↓	11:25	↓	16oz	↓	DWW-14A			✓	✓		✓	✓	✓	✓	✓	✓	
	9/6/02	11:25	SOIL	8oz	NONE	DWW-14AH					✓							

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9-6-2 1645	M Nett			

FOR LAB USE ONLY

Samples: WC___ MICRO___ BIO___ AA___ SV___ VOA___ pH? Y/N TEMP:___ SEALED: Y/N INTACT: Y/N

BD: BIO___ WC___ AA___

CC: AA___ SV___ VOA___

SIL: HP___ PT___ QT___ VOA___

W/HNO$_3$___ H$_2$SO$_4$___ NaOH___

PIL: HNO$_3$___ H$_2$SO$_4$___ NaOH___ HCL___

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R___ PR___ M___ F___

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SAMPLE CHAIN OF CUSTODY

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PAGE 2 OF 4

LAB ORDER #:

CLIENT: DWR

PROJECT # / PROJECT NAME: DELTA WETLANDS - WEBB TRACT

P.O. #:

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): DON (GUY) / JIM (SLEIM) DONKEY

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	TITLE 22 Metals TLC	CR VI Title 22	BTEX / MTBE	OIL / GREASE	ORGANOCHLORINE PESTICIDES	PCB	PAH	Chlorinated [illegible] Comp.	REMARKS
	9/6/02	11:32	SOIL	16 oz	NONE	DWW-14B1		COMP	✓	✓	✓	✓	✓	✓	✓	✓		
		11:32		16 oz		DWW-14B2			✓	✓	✓	✓	✓	✓	✓	✓		
		1132		8 oz		DWW-14BH1			✓									
		1132		8 oz		DWW-14BH2		COMP.	✓									
		1140		16 oz		DWW-15A		GRAB	✓	✓	✓	✓	✓	✓	✓	✓		
		1140		8 oz		DWW-15AH			✓									
		11:45		16 oz		DWW-15B			✓	✓	✓	✓	✓	✓	✓	✓		
		11:46		8 oz		DWW-15BH			✓									
		1153		16 oz		DWW-16A			✓	✓	✓	✓	✓	✓	✓	✓		
	9/6/02	1154	SOIL	8 oz	NONE	DWW-16AH		GRAB	✓									

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9-6-02 1645	[signature]			

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ | pH? Y/N | TEMP:____ | SEALED: Y/N | INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO$_3$____ H_2SO_4____ NaOH____

PIL: HNO$_3$____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R____ PR____ M____ F____

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SAMPLE CHAIN OF CUSTODY

PAGE 3 OF 4

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - WEBB TRACT

P.O. #:

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95608

BILLING ADDRESS: SAME

PHONE #: 916 375-6008 FAX PHONE: (916) 375-6619

SAMPLER (PRINT & SIGN NAME): DON GUY / JIM GLEIM

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	TITLE 22 METALS TLC	CC VII TITLE 22	BTEX/MTBE	OIL/GREASE	ORGANOCHLORINE PESTICIDES	PCB	TAH	REMARKS
	9/6/02	1157	SL	SJ	NONE	DWW-16B		GRAB	✓		✓	✓	✓	✓	✓	✓	
		1158	SL	SJ		DWW-16BH				✓							
		1207	WQ	~~WAPT~~		DWW-17EB			~~✓~~	✓	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	
		1230	SL	SJ		DWW-18A			✓		✓	✓	✓	✓	✓	✓	
		1230	SL	SJ		DWW-18AH				✓							
		1247	SL	SJ		DWW-19A			✓		✓	✓	✓	✓	✓	✓	
		1247	SL	SJ		DWW-19AH		GRAB		✓							
		1340	SL	SJ		DWW-20A1		COMP	✓		✓	✓	✓	✓	✓	✓	
		1340	SL	SJ		DWW-20AH1		COMP		✓							
	9/6/02	1340	SL	SJ	NONE	DWW-20A2		COMP	✓		✓	✓	✓	✓	✓	✓	

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9.6.02 1645	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH? Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R____ PR____ M____ F____

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SAMPLE CHAIN OF CUSTODY

PAGE 4 OF 4

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - WEBB TRACT

P.O. #:

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): DON GUY / JIM GLEIM

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	EH	TITLE 22 METALS TTLC	CT TITLE 22	BTEX/MTBE	OIL/GREASE	ORGANOCHLORINE PESTICIDE	PCB	PAH	ORGANOPHOSPHOROUS COMPOUNDS	REMARKS
	9/6/02	1340	SL	SJ	NONE	DWW - 20AH2		COMP			✓							
	↓	1345	SL	SJ	↓	DWW - 20B		GRAB	✓	✓		✓	✓	✓	✓	✓	✓	
	↓	1345	SL	SJ	↓	DWW - 20BH		↓			✓							
	↓	1335	SL	SJ	↓	DWW - 21A		↓	✓	✓		✓	✓	✓	✓	✓	✓	
	↓	1335	SL	SJ	NONE	DWW - 21AH		↓			✓							
	↓	1350	AQ	VOA	HCl	DWW - FB1		↓				✓						
	9/6/02	1350	AQ	VOA	HCl	DWW - FB2		GRAB				✓						

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RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	9-6-02 16^45	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH? Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO$_3$____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R______ PR______ M______ F______

REV. 2/99

WHITE - LABORATORY YELLOW - CLIENT COPY TO ACCOMPANY FINAL REPORT PINK - CLIENT COPY AS RECEIPT

Caltest ANALYTICAL LABORATORY

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SAMPLE CHAIN OF CUSTODY

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - BACON ISLAND

P.O. #:

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019 SAMPLER (PRINT & SIGN NAME): CHRIS HUITT / JIM GLEIM

ANALYSES REQUESTED

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	TITLE 22 METALS TTLC	CR VI TITLE 22	BTEX/MTBE	OIL/GREASE	ORGANOCHLOR. PESTICIDES	PCB	PAH	ORGANOPHOS. COMPOUNDS	REMARKS
	9/9/02	10:22	SOIL	SJ	NONE	DWB-22A		GRAB	✓	✓		✓	✓	✓	✓	✓	✓	
		10:22	SL	SJ		DWB-22AH					✓							
		10:55	SL	SJ		DWB-23A			✓	✓		✓	✓	✓	✓	✓	✓	
		10:55	SL	SJ		DWB-23AH		GRAB			✓							
		11:00	SL	SJ		DWB-24B1		COMP	✓	✓		✓	✓	✓	✓	✓	✓	
		11:00	SL	SJ		DWB-24BH1		COMP			✓							
		11:00	SL	SJ		DWB-24B2		COMP	✓	✓		✓	✓	✓	✓	✓	✓	
		11:00	SL	SJ		DWB-24BH2		COMP			✓							
		11:25	SL	SJ		DWB-25A		GRAB	✓	✓		✓	✓	✓	✓	✓	✓	
	9/9/02	11:25	SL	SJ	NONE	DWB-25AH		GRAB			✓							

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FOR LAB USE ONLY

Samples: WC ____ MICRO ____ BIO ____ AA ____ SV ____ VOA ____ pH? Y/N TEMP: ____ SEALED: Y/N INTACT: Y/N

BD: BIO ____ WC ____ AA ____

CC: AA ____ SV ____ VOA ____

SIL: HP ____ PT ____ QT ____ VOA ____

W/HNO_3 ____ H_2SO_4 ____ NaOH ____

PIL: HNO_3 ____ H_2SO_4 ____ NaOH ____ HCL ____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R ____ PR ____ M ____ F ____

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SAMPLE CHAIN OF CUSTODY

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - BACON ISLAND

P.O. #:

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019 SAMPLER (PRINT & SIGN NAME): CHRIS HUITT / JIM GLEIM

ANALYSES REQUESTED

TURN-AROUND TIME ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	[illegible]	TITLE 22 METALS TTLC	CR VI / TITLE 22	BTEX / MTBE	OIL / GREASE	ORGANOCHLO. PESTICIDES	PCB	PAH	ORGANOPHOS. PESTICIDES	REMARKS
	9/9/02	11:30	SL	SJ	NONE	DWB-25B			/	/		/	/	/	/	/	/	
	↓	11:30	SL	SJ	↓	DWB-25BH					/							
		11:20	SL	SJ		DWB-26A			/	/		/	/	/	/	/	/	
		11:20	SL	SJ		DWB-26AH					/							
		11:25	SL	SJ		DWB-26B			/	/		/	/	/	/	/	/	
		11:25	SL	SJ		DWB-26BH					/							
		12:07	SL	SJ		DWB-27A			/	/		/	/	/	/	/	/	
		12:07	SL	SJ		DWB-27AH					/							
		12:50	SL	SJ		DWB-28A			/	/		/	/	/	/	/	/	
	9/9/02	12:50	SL	SJ	NONE	DWB-28AH					/							

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FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH?: Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO$_3$____ H$_2$SO$_4$____ NaOH____

PIL: HNO$_3$____ H$_2$SO$_4$____ NaOH____ HCL____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

R____ PR____ M____ F____

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Caltest
ANALYTICAL LABORATORY

SAMPLE CHAIN OF CUSTODY

LAB ORDER #:

PROJECT #/PROJECT NAME: DELTA WETLANDS - BACON ISLAND

P.O. #

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019

SAMPLER (PRINT & SIGN NAME): CHRIS HUITT / JIM GLEIM

TURN-AROUND TIME ☐ STANDARD ☐ RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH		Title 22 Metals TTLC	CA III Title 22	BTEX/MTBE	Oil/Grease	Organochloro. Pesticides	PCB	PAH	Organophos. Compounds	REMARKS
	9/9/02	1300	SOIL	SJ	NONE	DWB - 28B1		Comp	✓	✓		✓	✓	✓	✓	✓	✓		
		1300				DWB - 28BH1		Comp			✓								
		1305				DWB - 29A		Grab	✓	✓		✓	✓	✓	✓	✓	✓		
		1305				DWB - 29AH		Grab			✓								
		13:12				DWB - 29B		Grab	✓	✓		✓	✓	✓	✓	✓	✓		
		13:12				DWB - 29BH		Grab			✓								
		1300				DWB - 28B2		Comp	✓	✓		✓	✓	✓	✓	✓	✓		
		1300				DWB - 28BH2		Comp			✓								
		9:10				DWB - 29EB		Grab		✓	✓								
	9/9/02																		

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Samples: WC ____ MICRO ____ BIO ____ AA ____ SV ____ VOA ____ pH? Y/N TEMP: ____ SEALED: Y/N INTACT: Y/N

BD: BIO ____ WC ____ AA ____

CC: AA ____ SV ____ VOA ____

SIL: HP ____ PT ____ QT ____ VOA ____

W/HNO_3 ____ H_2SO_4 ____ NaOH ____

PIL: HNO_3 ____ H_2SO_4 ____ NaOH ____ HCL ____

COMMENTS

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL VOA; OTC = Other Type Container

R ____ PR ____ M ____ F ____

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SAMPLE CHAIN OF CUSTODY

PAGE 1 OF 2

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS - BOULDIN IS.

P.O. #:

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERSIDE RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019 SAMPLER (PRINT & SIGN NAME): CHRIS HUTT / JIM GLEIM

ANALYSES REQUESTED

TURN-AROUND TIME ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	pH	TITLE 22 METALS TLC	Cr VI TITLE 22	BTEX/MTBE	OIL/GREASE	ORGANOCHLORO. PESTICIDES	PCB	PAH	ORGANOTIN COMPOUNDS	REMARKS
	9/10/02	9:07	AQ	VOA	HCl	DWL - FB3		Grab				/						
		9:07	AQ	VOA	HCl	DWL - FB4		Grab				/						
		9:20	SL	SJ	NONE	DWL - 30A1		Comp	/	/		/	/	/	/	/	/	
		9:20	SL	SJ		DWL - 30AH1		Comp			/							
		9:20	SL	SJ		DWL - 30A2		Comp	/	/		/	/	/	/	/	/	
		9:20	SL	SJ		DWL - 30AH2		Comp			/							
		9:35	SL	SJ		DWL - 30B		Grab	/	/		/	/	/	/	/	/	
		9:35	SL	SJ		DWL - 30BH		Grab			/							
		9:40	SL	SJ		DWL - 30C		Grab	/	/		/	/	/	/	/	/	
	9/10/02	9:40	SL	SJ	NONE	DWL - 30CH		Grab			/							

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Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ pH? Y/N TEMP:____ SEALED: Y/N INTACT: Y/N

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

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SAMPLE CHAIN OF CUSTODY

PAGE 2 OF 2

LAB ORDER #:

PROJECT # / PROJECT NAME: DELTA WETLANDS – BOULDIN IS.

P.O. #

CLIENT: DWR

REPORT TO: BILL NICKELS

ADDRESS: 1450 RIVERBANK RD. CITY: WEST SACRAMENTO STATE: CA ZIP: 95605

BILLING ADDRESS: SAME

PHONE #: (916) 375-6008 FAX PHONE: (916) 375-6019

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DUE DATE:

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	9/10/02	9:55	SL	SJ	NONE	DWL - 31A		Grab	✓	✓		✓	✓	✓	✓	✓	✓	
	"	9:55	SL	SJ	|	DWL - 31AH		|			✓							
	|	10:40	SL	SJ	|	DWL - 32A		|	✓	✓		✓	✓	✓	✓	✓	✓	
	|	10:40	SL	SJ	NONE	DWL - 32AH		|			✓							
	9/10/02	12:40	AQ	PT	HCl	DWL - 32EB		Grab		✓	✓							

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FOR LAB USE ONLY

Samples: WC___ MICRO___ BIO___ AA___ SV___ VOA___ pH? Y/N TEMP:___ SEALED: Y/N INTACT: Y/N

BD: BIO___ WC___ AA___

CC: AA___ SV___ VOA___

SIL: HP___ PT___ QT___ VOA___

W/HNO_3___ H_2SO_4___ NaOH___

PIL: HNO_3___ H_2SO_4___ NaOH___ HCL___

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